MODERN PLASTICS

November 1956

page 49 **The Plastiscope, Section 1 . . .**

vital news of the industry

page 131 **New markets for molded nylon**

How

DUREZ RESINS

help you get better rubber stocks

Discover the benefits now available for your product or components through the use of Durez resin in various types of rubber.

For example, we list above some of the properties these resins improve in hard and semi-hard nitrile rubber stocks. The resin is completely compatible with synthetic rubber of this type. Through chemical reactivity it contributes strongly to vulcanization, reinforcement, abrasion resistance, and other qualities.

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Another new development using

MODERN PLASTICS*

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Number 3

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Editorial

Coming battle in building

With upwards of 16,000,000 new homes to be built in the next decade, with over 30% of our present homes to be remodeled, and with plastics enjoying well-deserved public approval, the steel, aluminum, lumber, concrete, and glass interests are quite naturally exercised about competition of plastics in building.

The fact that plastics structural engineering is progressing so fast is part of this picture. Involved are new architectural space and area concepts. To the dome, the arch, and the pillar have been added "composite bents" and "hyperbolic paraboloids," structures built to exist in tension, which peculiarly lend themselves to the use of plastics and to recognized plastics processing methods.

The makers of materials which will compete with plastics in the building field are preparing to do battle in two ways. First, where they have some hope of forestalling a certain use of plastics, they propose to hammer home the present "superiority" of their materials. Second, where they know that plastics are going to take over, they are moving into plastics. An example of the former approach is the immense public relations program to builders, architects, and consumers on the part of the aluminum interests. An example of the second way is the recent announcement of a plastic-clad steel sheet by the largest steel producer.

Big, big money is involved in the battle for this tremendous market. The Society of the Plastics Industry staged a small home design competition for architects and student architects. Results were favorable and some public and trade interest was promoted. But when the National Association of Architectural Metal Manufacturers staged an "aluminum curtain wall competition," the total prizes offered amounted to five times as much as those offered by the plastics industry. Indeed, the first prize in the aluminum competition was $10,000—that of the plastics competition $1000.

One plastics material maker is now preparing to build at great cost a complete plastics home embodying the results of extensive research. This is good, but not enough. While code committees are doing yeoman service in furthering the acceptance of plastics on the basis of standards, that is not enough either. What we need to join this battle is a continuing, coordinated program of development, promotion, and public relations which should be contributed to by every company in the plastics industry that hopes to gain a share of the building market.

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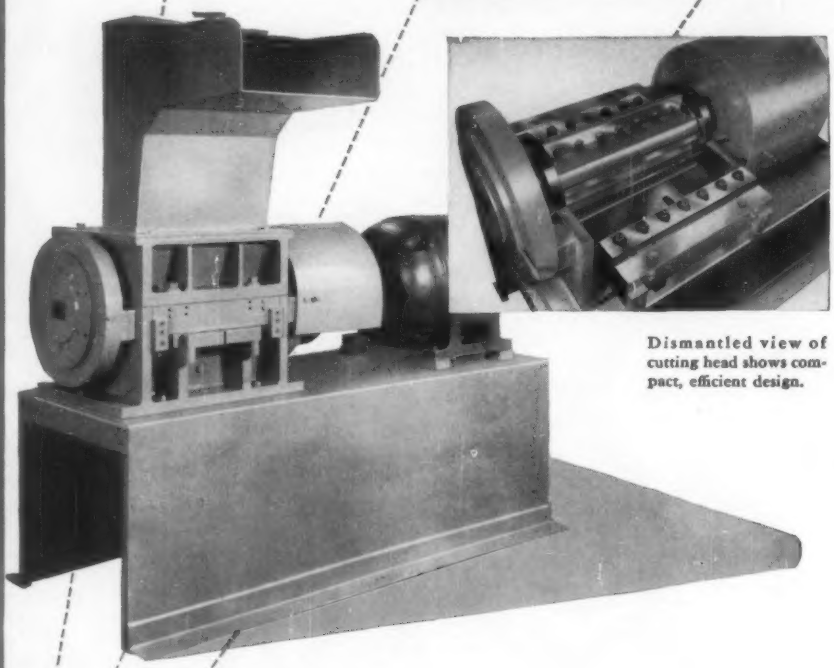
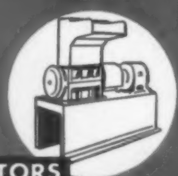


Dismantled view of cutting head shows compact, efficient design.

In Plastics Reducing Machinery, Look to CUMBERLAND for the COMPLETE LINE



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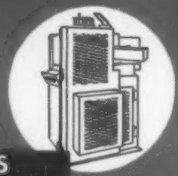

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CHOPPERS

PREBREAKERS

1 HEAVY DUTY — Large flywheel—thick all-steel weldments—deep welds—parts are of flawless wrought steel (not steel castings)—machine resists wreckage.

2 LARGE THROAT OPENING — 8 by 20″ size.

3 PRIOR BANDSAWING NOT NEEDED — Machine specially built to handle large chunky parts such as bleeder scrap, cylinder purgings and heavy cast slabs of polystyrene, modified polystyrene and acrylic resins.

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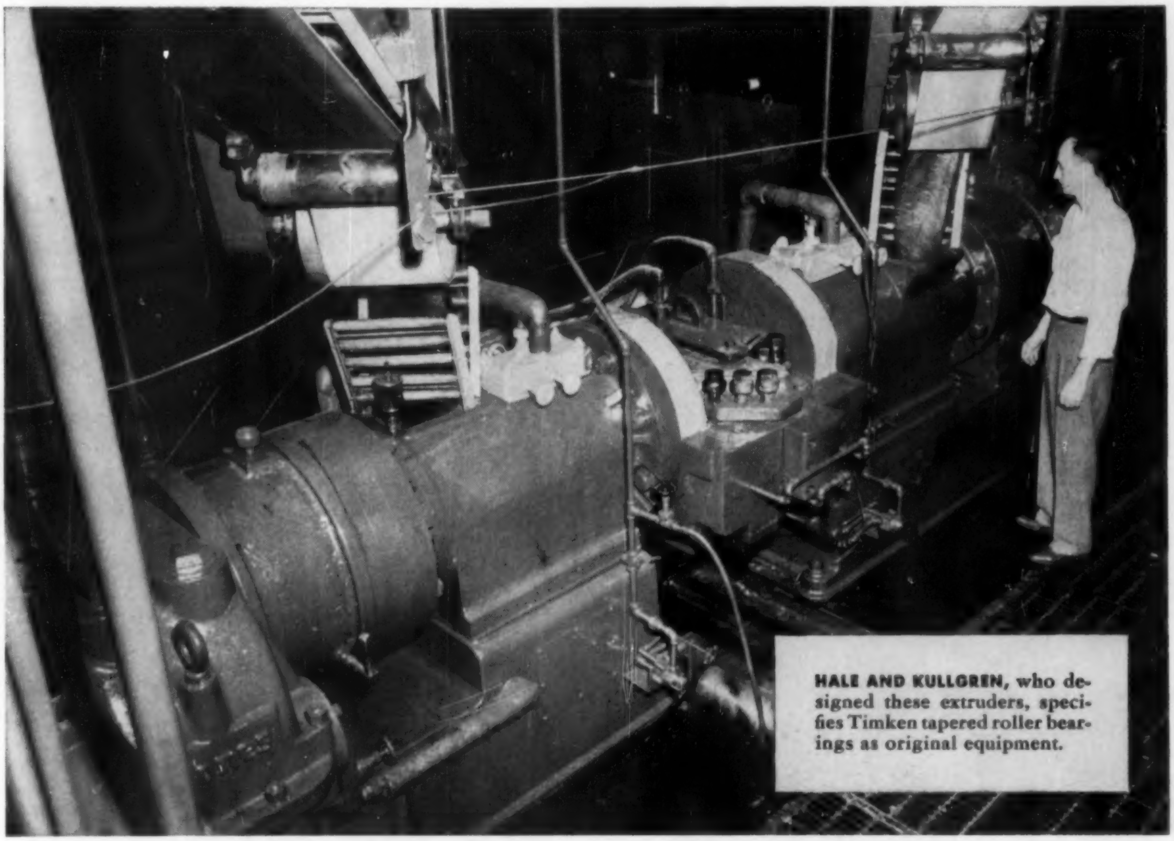

HALE AND KULLGREN, who designed these extruders, specifies Timken tapered roller bearings as original equipment.

Outstanding proof that TIMKEN® bearings can take whopping thrust loads

TWENTY-FOUR hours a day, year after year, these National Erie rubber extruders, redesigned by Hale and Kullgren, Incorporated, and built by Aetna-Standard Engineering Company, are kept in continuous operation.

Timken® tapered roller bearings are mounted on sleeves in the independent thrust units of these machines. As a result of their tapered construction, Timken bearings carry thrust and radial loads in any combination. Because of the tremendous thrust load encountered in this application, a large, steep-angle bearing was specified.

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In no other bearing can you get the combination of advantages which Timken bearings give you. Specify Timken bearings in the equipment you build or buy. Look for the trade-mark "Timken" stamped on every bearing. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.

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At a new plant in Bucyrus, Ohio, the Timken Company has substantially reduced the cost of tapered roller bearings by: 1) producing these bearings under a new system of extreme mechanization; 2) standardizing on 13 bearing sizes with the widest applications throughout industry. Manufacturers can take advantage of these lower costs by redesigning applications to use these Bucyrus sizes. And as more switch to Bucyrus bearings, production costs can drop still further, meaning even lower costs to you.

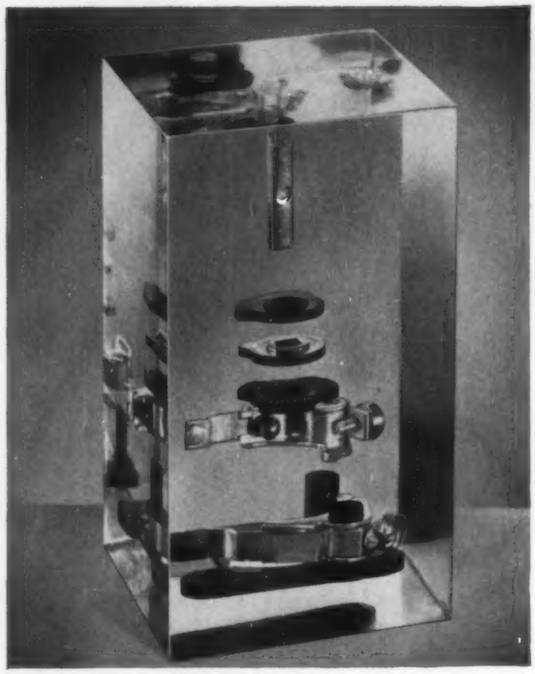
TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

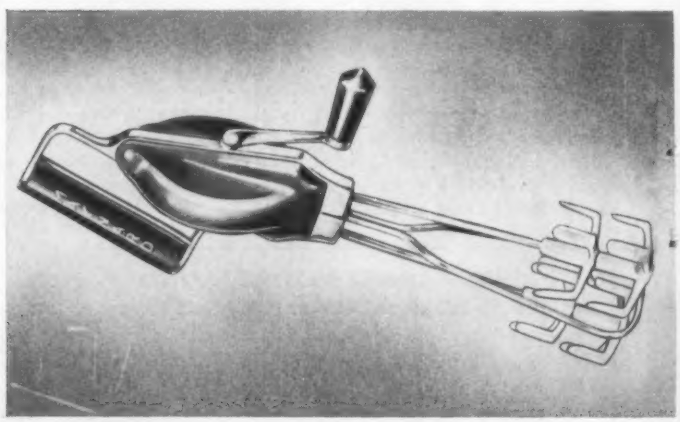
TAPERED ROLLER BEARINGS

NOT JUST A BALL NOT JUST A ROLLER THE TIMKEN TAPERED ROLLER BEARING TAKES RADIAL AND THRUST LOADS OR ANY COMBINATION

4 more examples



LUCITE® provides interesting industrial embedments such as this. A variety of products can be embedded in crystal-clear LUCITE, either singly or in patterns, giving instructive and attractive exploded-view effects.



ALATHON® is lightweight, tough, and shatterproof. Water- and chemical-resistant, ALATHON is a superior material for use in housewares.

ZYTEL® is used for ten parts of this lightweight household mixer. ZYTEL absorbs shocks and assures silent operation in all types of mechanical parts.

# of advanced product engineering

Manufacturers are replacing conventional materials with Du Pont engineering materials because their use can often simplify designs, increase product efficiency, and lower costs. Here are typical examples of design improvement. They may suggest ways in which you can utilize these versatile materials in your operation.

ALATHON® polyethylene resin is specially suited for the manufacture of housewares. It is light in weight, tough and flexible over a wide range of temperatures, has excellent chemical and water resistance, and is free from taste, odor and toxicity. Colorful housewares of ALATHON will not crack, chip or peel and they are shatterproof. (Housewares manufactured by Loma Plastics, Inc., Fort Worth, Texas.)

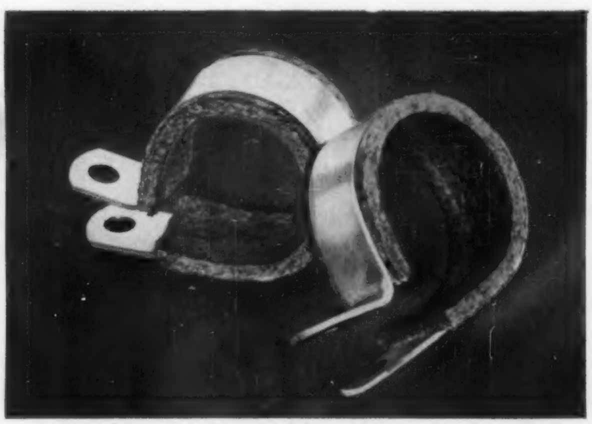
LUCITE® acrylic resin adds beauty and durability to embedments of all types. Products embedded in clear LUCITE are transformed into miniature sales showcases that can be handled indefinitely without growing grimy and losing their promotional value. LUCITE also has wide application in the fields of architecture, lighting, signs and displays. It can be economically fabricated by several efficient techniques. (Embedment by Karv Art Products Mfg. Co., Camden, New Jersey.)

ZYTEL® nylon resin is used in the blades, bearings, and pinion gears of this new mixer. ZYTEL was chosen for these components because it requires no lubrication and is resistant to hot water, strong detergents and greases. ZYTEL maintains its high impact strength at sub-zero temperatures and form stability above 300°F. Injection-molded or extruded, ZYTEL is light in weight — yields more parts per pound. (ZYTEL molded by Coast Craft Industries, Glendale, California, for Maynard Manufacturing Company, Glendale 5, California.)

TEFLON ® tetrafluoroethylene resin is used in "Jo-clamps," initially developed for the aircraft industry. Liners are impregnated with TEFLON for excellent chemical stability and age resistance over a wide temperature range. Will not char or carbonize. In this and other applications, the self-lubricating characteristics of TEFLON assume importance. A coefficient of friction of TEFLON as low as .04 has been measured. TEFLON has good impact strength and toughness at temperature extremes of 500°F. to -450°F. (Manufactured by the Joclin Manufacturing Company, North Haven, Connecticut.)

* * *

Send for free details. Why not evaluate your own design problems in terms of the Du Pont engineering materials? Complete property and application data is available to you without cost or obligation. Clip and mail the coupon.



TEFLON ® gives resiliency to this clamp. TEFLON performs efficiently at extremely high temperatures and has excellent chemical stability and age resistance.

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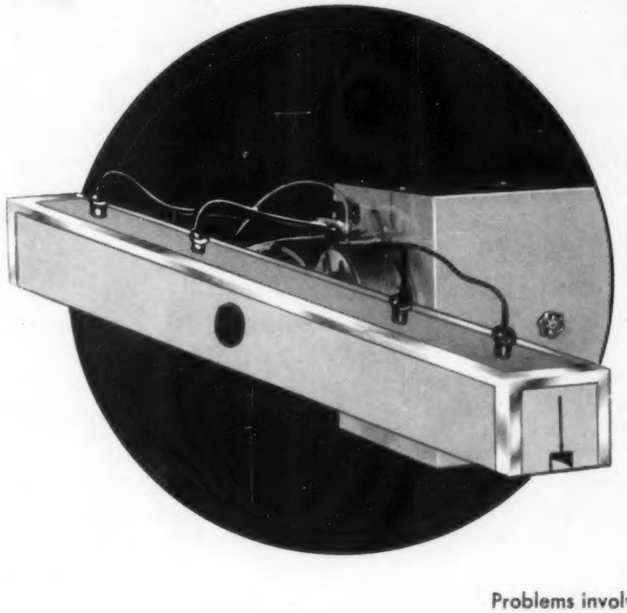
Of Course... with mpm



SPECIALLY DESIGNED DIES

More, better, efficient production is the reason why MPM equipment is so widely used.

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mpm

modern plastic machinery corp.

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clue to covering

One of the fastest-moving items in today's protective-covering field is vinyl-coated nylon. Combining light weight with high strength, impermeability to water and gases, resistance to oils and chemicals, flexibility at low temperatures plus excellent weatherability, this new type of tarp is finding wide use on everything from small skiffs to truck trailers to big baseball and football fields.

Clue to coating nylon successfully lies not only in careful selection and compounding of materials, but in their proper application. One leading manufacturer builds up to the current coating thickness with a number of light applications, individually fused, under closely controlled conditions to cancel out variables. As a result, precise control of the viscosity of the coating is essential and that's why he uses PLIOVIC AO.

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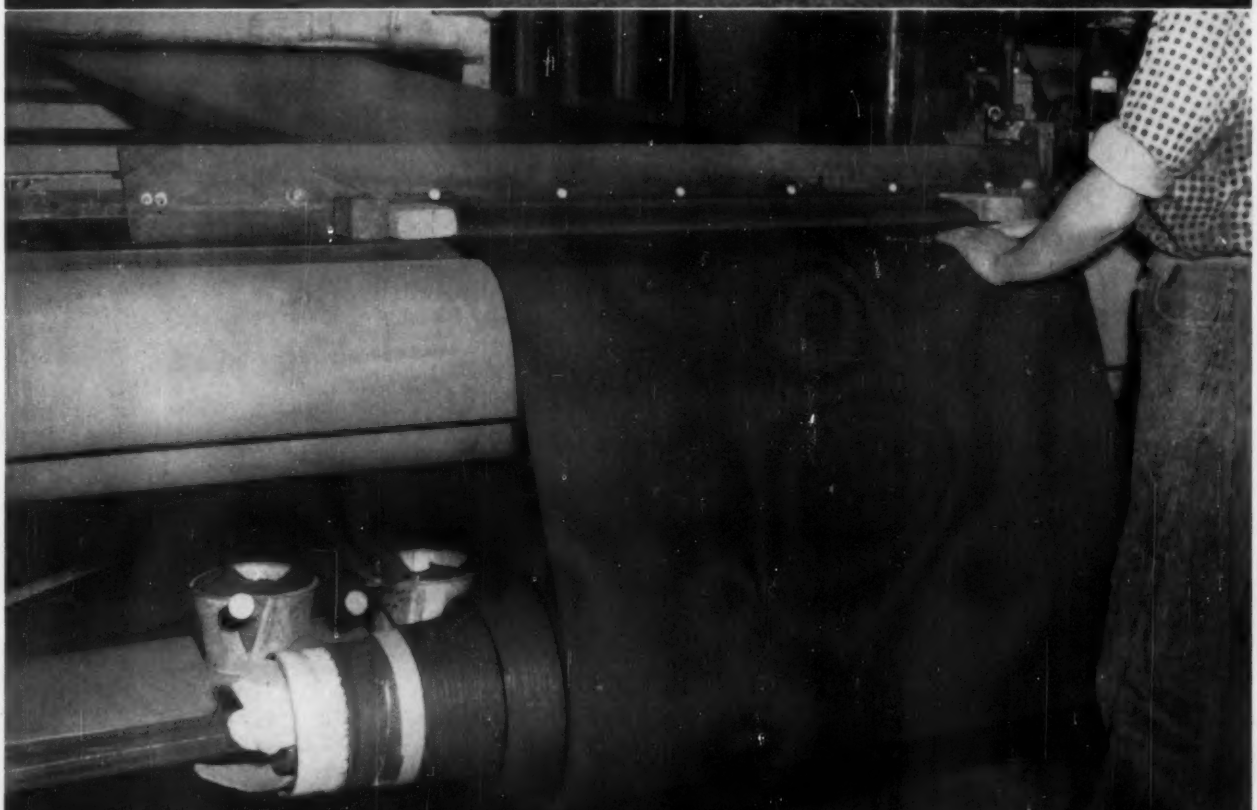
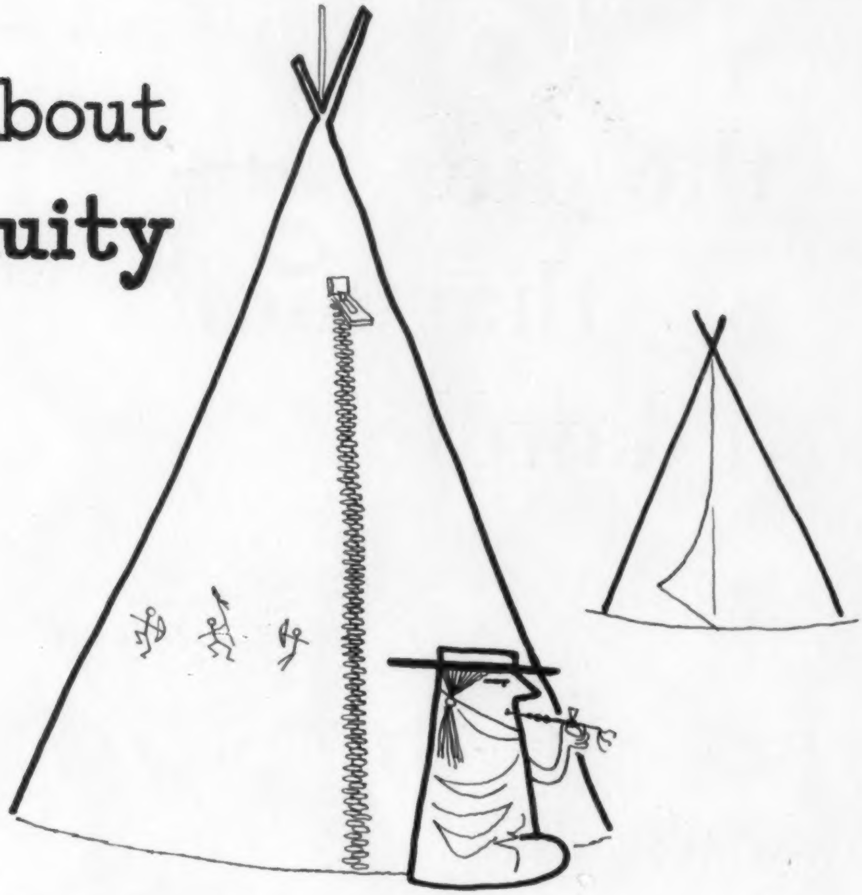
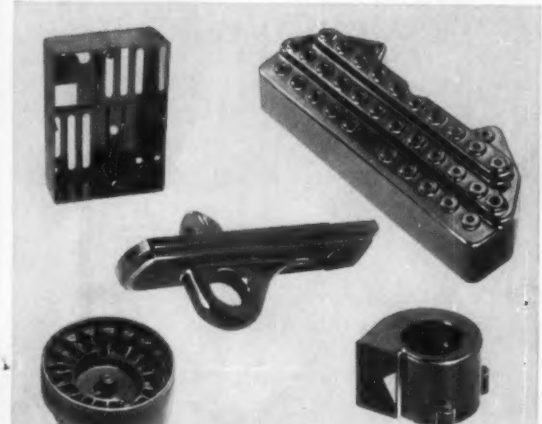


Photo courtesy Sawyer, Tower, Inc., Coated Fabrics Division, Watertown, Mass.

talk about injunuity





in plastics too... ...you'll find it, *without reservation,* at Kurz-Kasch. We keep our wigs warm worrying about your plastic problems. The more complex the shape, the more intricate the mold . . . the more we enjoy *unzipping your woes.* We have the men, the equipment, *and many moons behind us!* We can efficiently handle your job completely from design to finish! Compression, transfer and plunger molding are second nature to us. *In one pow-wow,* we can tell you if your part can best be molded in one of the standard thermosetting plastics or if the newer Teflon or glass-filled polyesters would serve you better.

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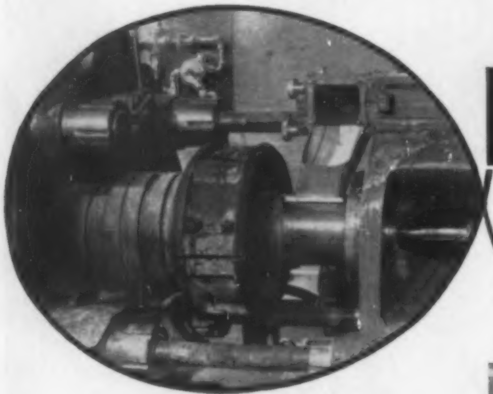
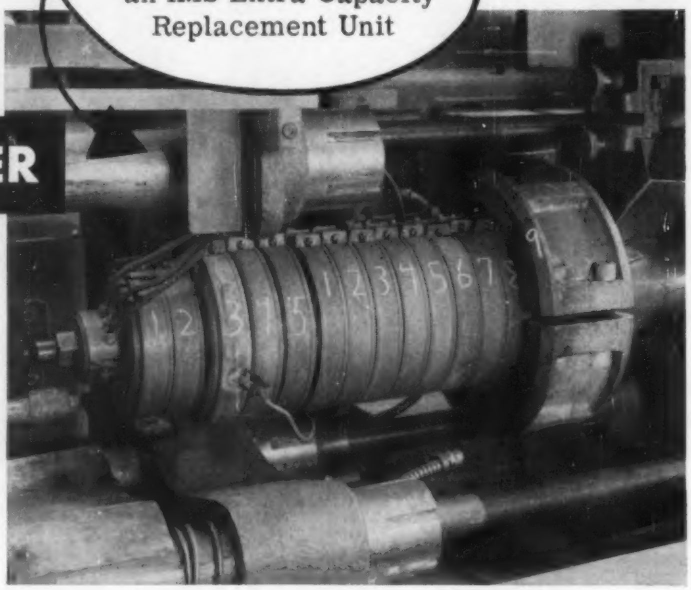
IMS REPLACEMENT HEATING CYLINDERS FOR ALL INJECTION MACHINES

HERE'S A TYPICAL CASE



BEFORE — *Standard Reed 8 with Out-Dated Original Equipment Heating Cylinder*

It's as easy as changing a regular heater to install an IMS Extra Capacity Replacement Unit



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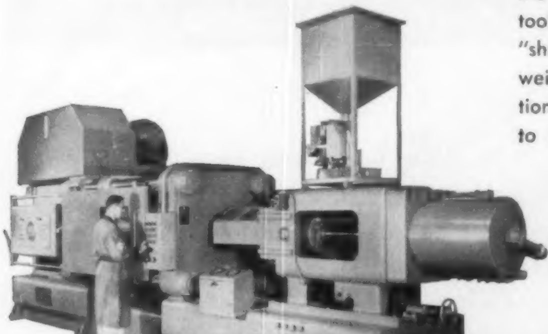

HPM

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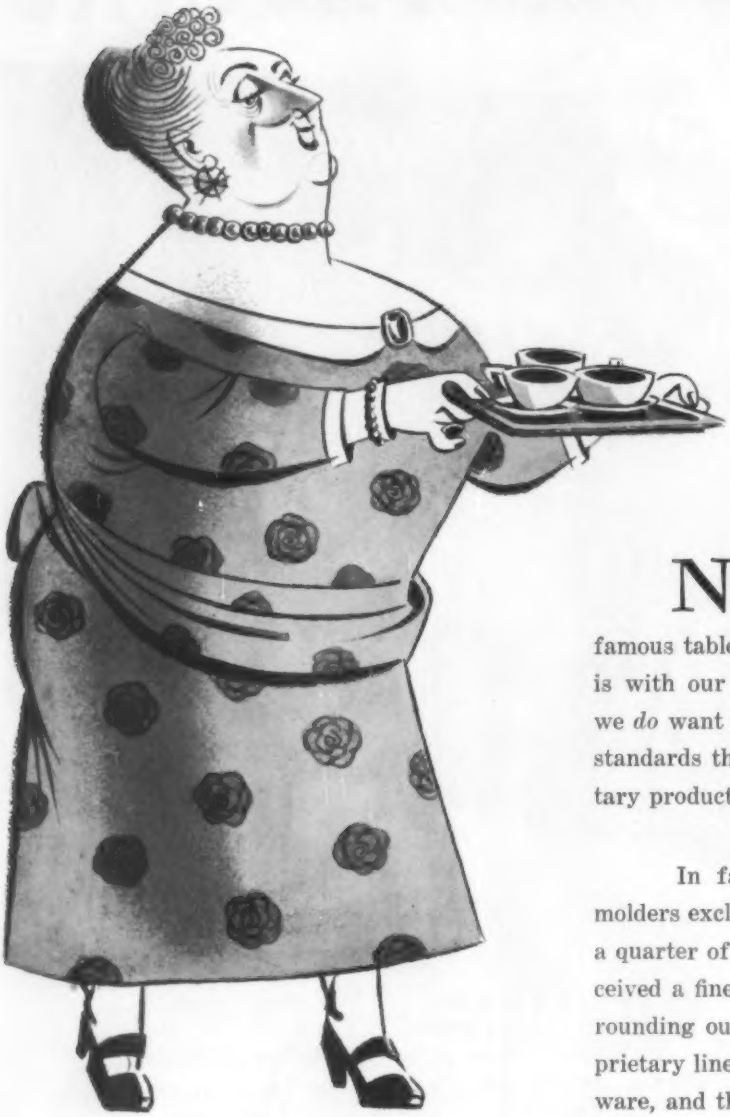
It's Boontonware, of course!



No, we're not trying to sell our famous tableware here. Our present concern is with our custom molding activities. But we *do* want you to know that the same high standards that set the pace for our proprietary products apply in our Custom Division.

In fact, we started out as custom molders exclusively, and stayed that way for a quarter of a century. Our work always received a fine reception, so we thought about rounding out our activity by adding a proprietary line. We decided upon quality tableware, and thus the Boontonware brand was born.

So while we actually have both divisions within the company, we like to think of ourselves as the outfit that takes a *proprietary* interest in every *custom* job.

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BOONTON, NEW JERSEY

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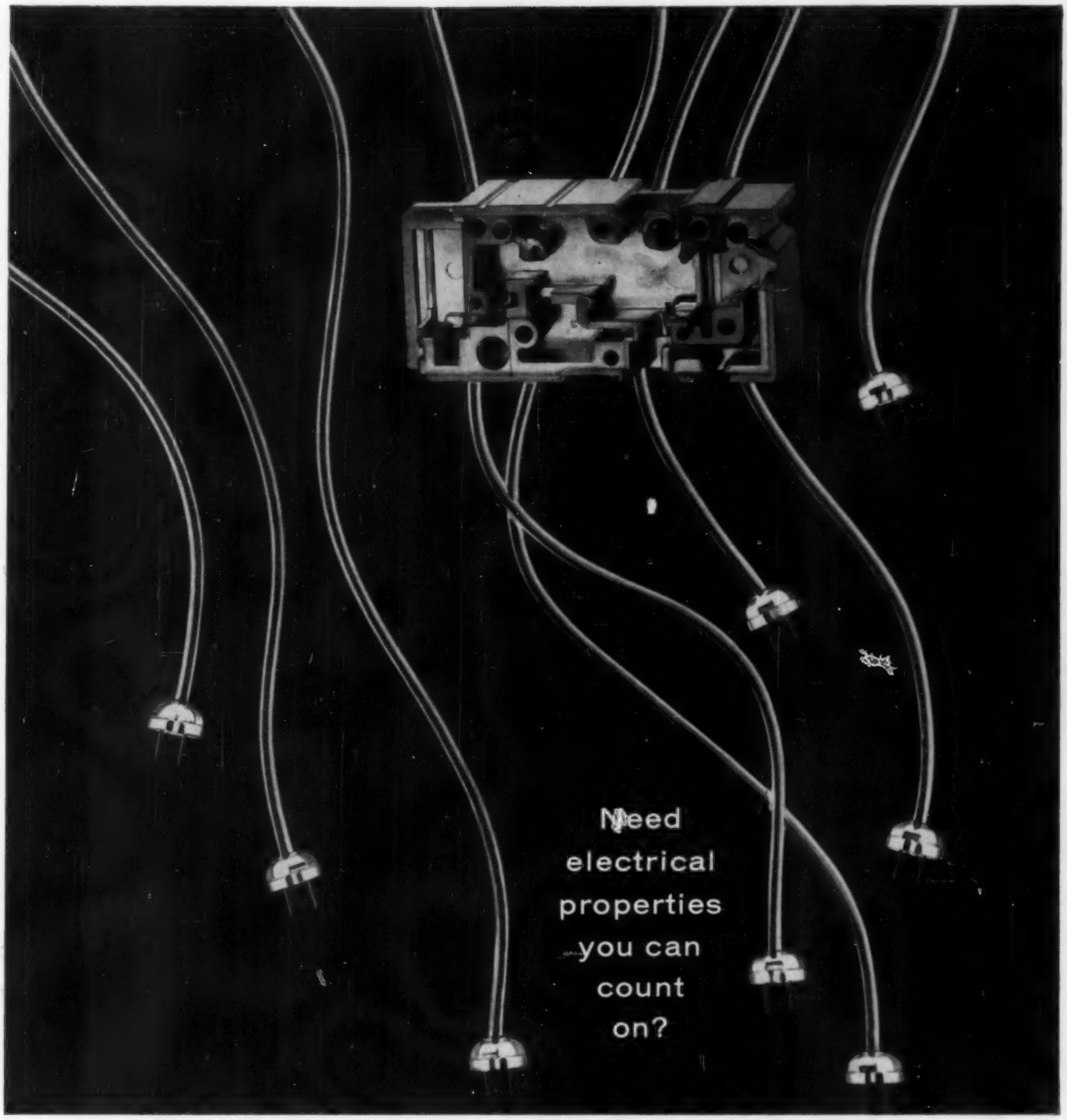


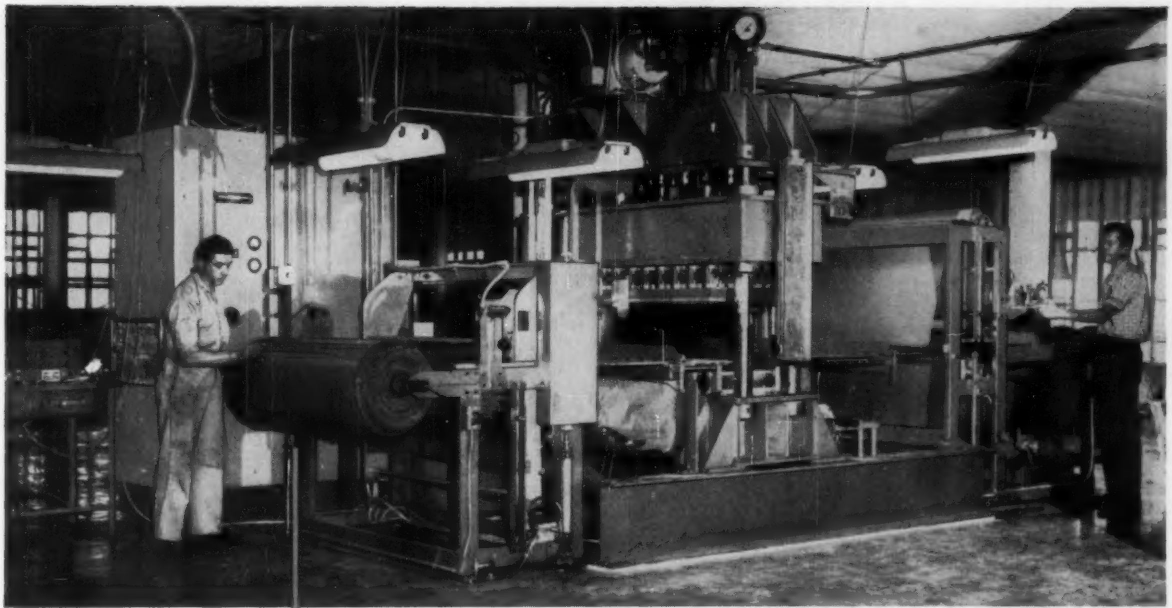
count on **Plenco**

Click, it's on—click, it's off. Multiply by several billion for the number of times this simple act takes place daily on our ultra-electrified planet. In the modest switch-box as well as in the manufacture of countless other more intricate electrical parts... specifying Plenco phenolic compounds of durability and self-insulating qualities is the first order of business of many experienced molders. We invite you to make it yours.

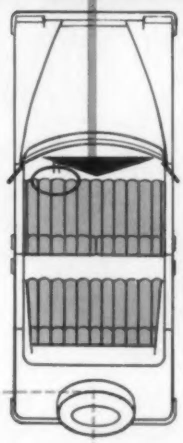
PLENCO PHENOLICS
FOR BETTER PLASTIC PRODUCTS

PLASTICS ENGINEERING COMPANY
Sheboygan, Wisconsin

Serving the plastics industry in the manufacture of high grade phenolic molding compounds, industrial resins and coating resins.



At the Masland Duraleather plant in Philadelphia, sheets of Masland Duran vinyl plastic are electronically welded to a backing, producing a handsome quilted upholstery fabric for automobiles and other uses. The work is done by a large, completely automated Thermatron press in conjunction with a Thermatron generator and indexer. Full rolls of plastic are fed into the press, quilted and rewound in one continuous operation with only supervisory operators.



America's newest cars owe so much to plastics welded by

Thermatron®

HIGH FREQUENCY SEALING AND HEATING EQUIPMENT

Electronically welded plastic products for the automotive industry include . . .

- Door panels
- Upholstered seats
- Safety cushioning
- Convertible tops
- Reservoir bags for windshield wipers
- Interior head linings
- Visor pouches
- Tool kits
- Carburetor filters

You've admired that attractive upholstery in many new cars. It's vinyl plastic, weld-quilted by Thermatron equipment. Then there's the safety cushioning of the sun visors and dashboards. Thermatron does that too—welds and shapes the foam filled visor for more shock resistance.

Because of Thermatron, plastics have become an important part of modern automobile design, and the applications are unlimited. If *you* have a new plastic product in mind, our engineers will be glad to run tests on your own material and make suggestions. Write today to Dept. 110.

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R&R

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Vinyl compounders – *you benefit by specifying plasticizers made from*

Indoil

OXO ALCOHOLS

Here's how – You sell finished product by volume rather than by weight. You get the most volume at lowest cost by buying plasticizers on the basis of volume of finished product, not weight of finished product. At equal cost per pound Oxo Alcohol plasticizers such as DIOP and DDP are cheaper to use. Here is a comparison:

	DOP	DIOP	DDP
Density 20/4	0.983	0.983	0.963
EMC* at 1,600 psi	50.3	51.4	53.7

**Equivalent Modulus Concentration (phr)*

INDOIL plastics evaluation laboratory checks quality of INDOIL Alcohols by testing finished product. Here operator measures elongation of plasticized vinyl strip to determine Equivalent Modulus Concentration of plasticizer.

No need to reformulate—Compounders plasticizing with DOP need not refigure formulations in order to use DIOP or DDP. They can be modified by using this table:

	Ratio $\frac{\text{Plasticizer phr}}{\text{DOP phr}}$	
	100% Elong. at 1,600 psi	100% Elong. at 900 psi
DOP	1.000	1.000
DIOP	1.022	1.019
DDP	1.068	1.086

Contact your supplier – Ask your plasticizer manufacturer for samples of DIOP, DDP and other esters made with INDOIL Oxo Alcohols. INDOIL Chemical Company does not manufacture esters.

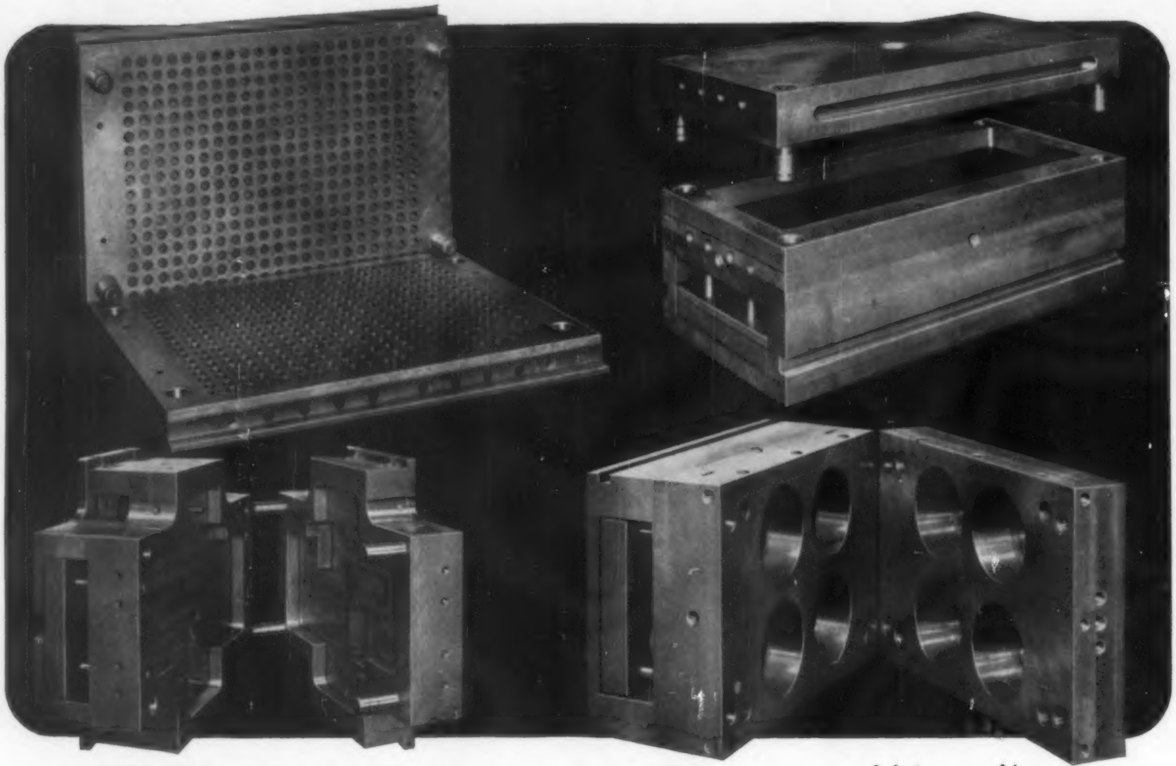
Information—Send for INDOIL Plasticizers from Oxo Alcohol Bulletins.

INDOIL® CHEMICAL PRODUCTS

INDOIL CHEMICAL COMPANY, 910 South Michigan Avenue, Chicago 80, Illinois

SPEED TREAT Steel Plate

for plastic mold and die cast die bases



The Columbia Engineering Co., Inc., Newark, N. J., profits greatly by using Speed Treat Steel Plate in the production of their die cast die and plastic mold bases. The "Columbia line" includes custom built nested plastic mold and die cast die bases, heating and cooling platens, ground plates, support columns, pressure pads, stripper bolts, auxiliary leader pins and bushings.

Shown here are four plastic bases Columbia built of "time-saving" Speed Treat Plate. Normally the steel is used in its as-rolled state, but for long run molds where the application demands it, Speed Treat is semi-hardened to 28-32 Rockwell C.

Speed Treat Plate meets the moldmakers' requirements as to service life, ease of machining, uniform hardening and savings in tool life. High polish and low deformation under pressure make Speed Treat a favorite with moldmakers and die cast diemakers from coast to coast.

Ask for our New Speed Steel Plate Bulletins:

Bulletin 541—SPEED CASE	low carbon free machining open hearth steel plate
Bulletin 542—SPEED TREAT	medium carbon free machining open hearth steel plate
Bulletin 543—SPEED ALLOY	High quality chrome-manganese alloy steel plate

THE SPEED STEELS ARE DISTRIBUTED COAST TO COAST BY THESE WAREHOUSES

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Grammer, Dempsey & Hudson, Inc.
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SPEED STEELS

JONES & LAUGHLIN STEEL WAREHOUSE DIVISION
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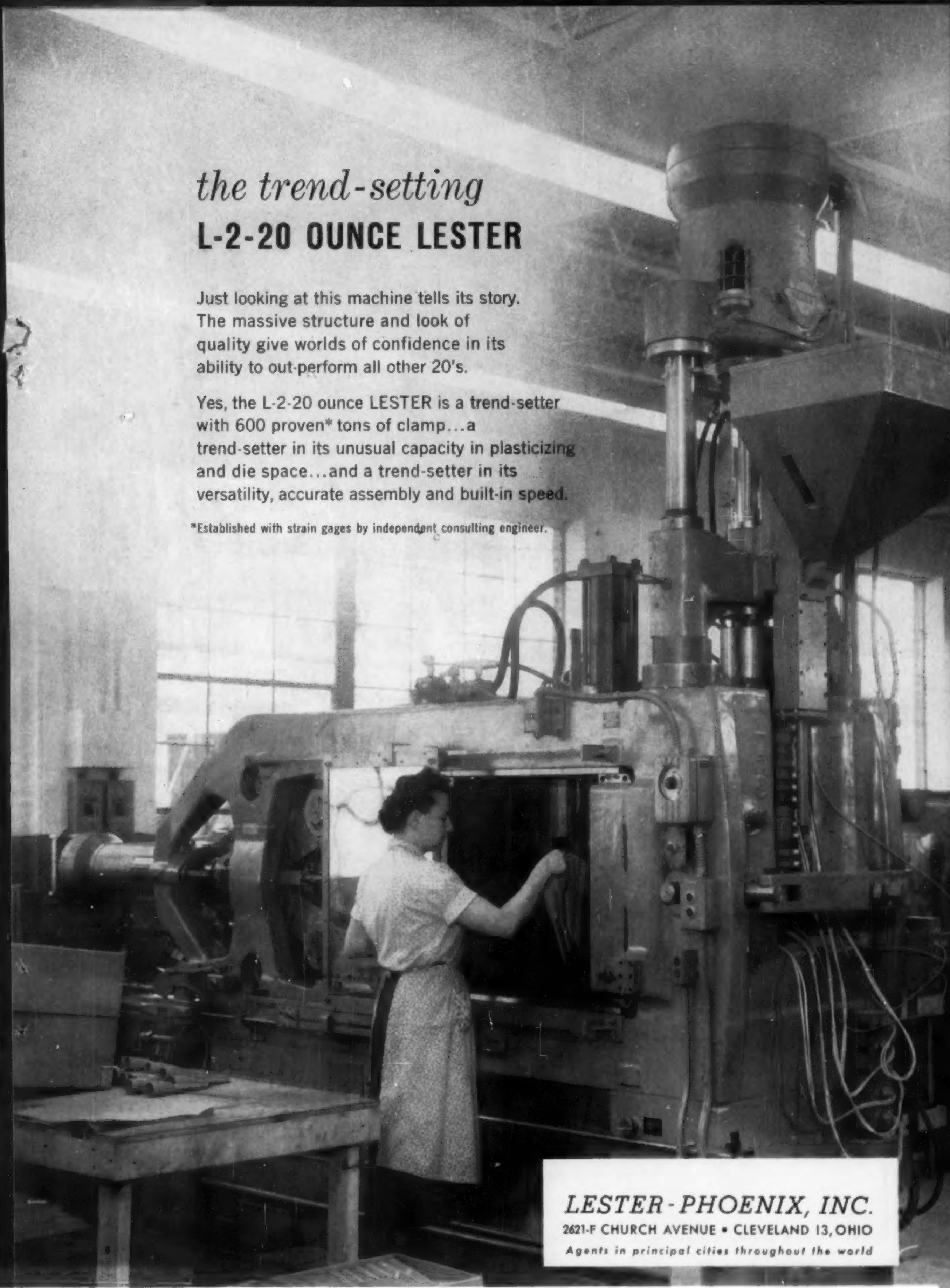
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L-2-20 OUNCE LESTER
Just looking at this machine tells its story. The massive structure and look of quality give worlds of confidence in its ability to out-perform all other 20's.
Yes, the L-2-20 ounce LESTER is a trend-setter with 600 proven* tons of clamp...a trend-setter in its unusual capacity in plasticizing and die space...and a trend-setter in its versatility, accurate assembly and built-in speed.
*Established with strain gages by independent consulting engineer.
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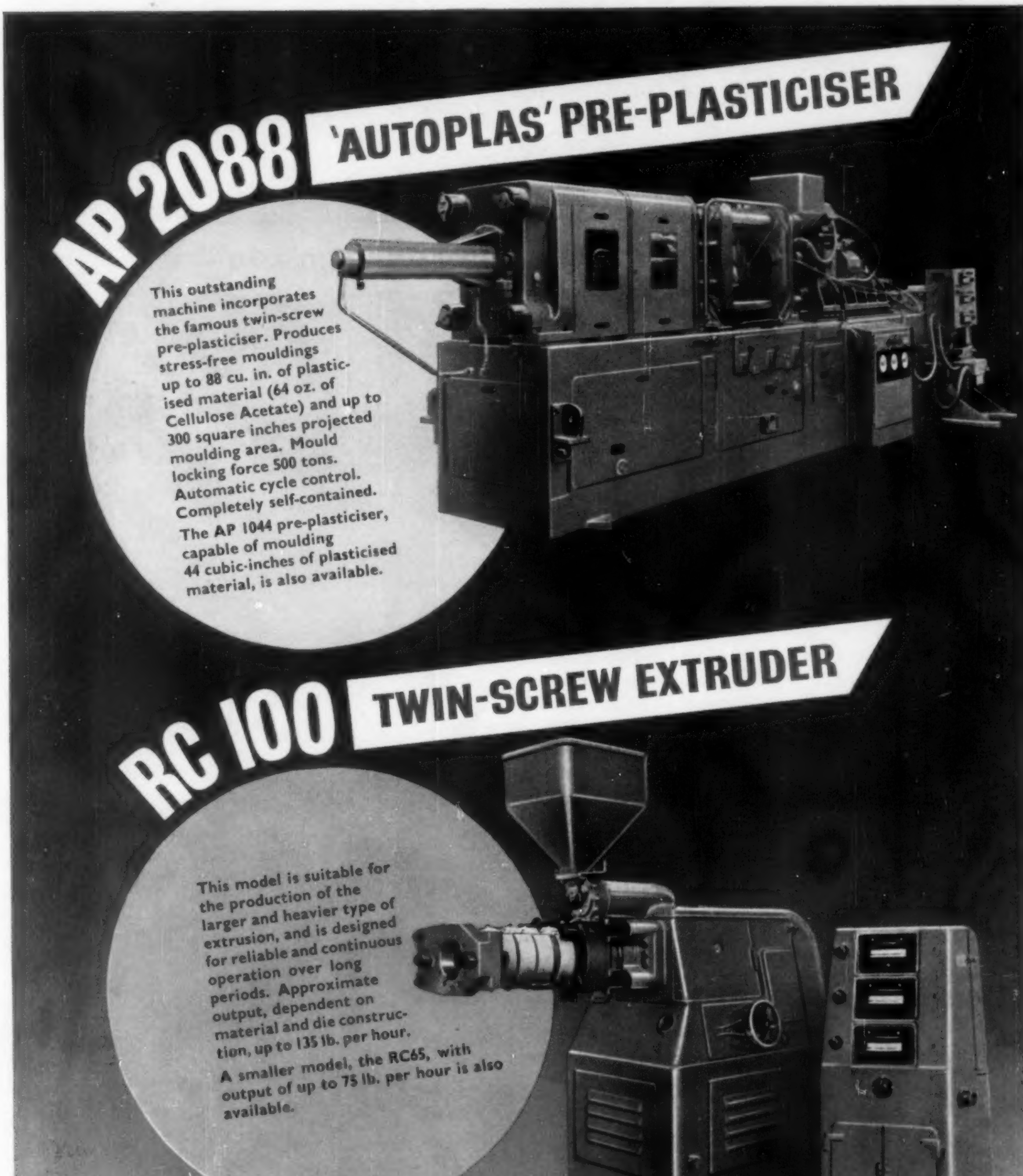


For vacuum and drape forming of Thermoplastic sheet

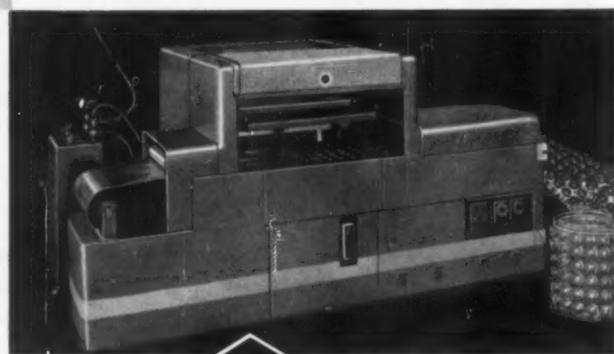
AUTO-VAC *Machines*

NOW . . . an Auto-Vac Machine for *any* vacuum forming operation.

- ***Quality*** . . . Pioneers in vacuum forming. More design firsts with Auto-Vac than any other. The most advanced and best engineered vacuum forming machine on the market.
- ***High Performance*** . . . Auto-Vac machines abound with automatic devices to help speed production and safeguard quality.
- ***Low Capital Investment*** . . . Auto-Vac machines are reasonably priced. Large mass production is not necessary to amortize machine investment.

AUTO-VAC

Work horse and most versatile of all vacuum forming machines. Five standard models from 24" x 36" to 48" x 72". Handles all thicknesses and all types of thermoplastic. Easily set up—easily operated—no maintenance needed.



SKIN PAK

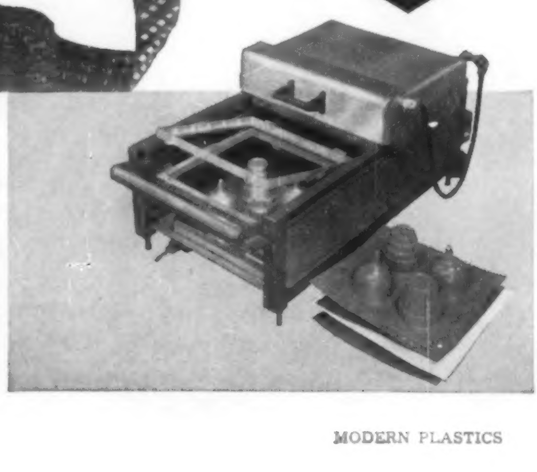
A low cost semi-automatic roll feed machine equipped for thin film work. Designed especially for SKIN PAK and blister packaging. Equally useful for production with heavier plastic.

ROLL VAC

Full automatic — fastest production machine on the market. Utilizes all plastic materials in rolls, and has automatic sheet cut-off. The ideal machine for high production—also for high speed SKIN-PAK packaging.

LAB-VAC

Ideal for the industrial designer, experimental work, schools, pilot and test runs, etc. Has most of the design features of its big brother AUTO-VAC.



Hundreds have chosen Auto-Vac. See why for yourself—ask for Bulletin 56 and free demonstration. Write . . .

The AUTO-VAC Company

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a team of specialists
on any slitting-winding problem

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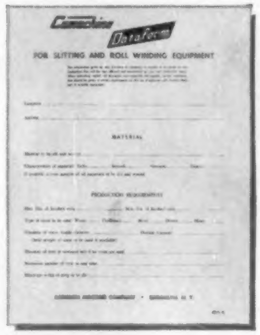

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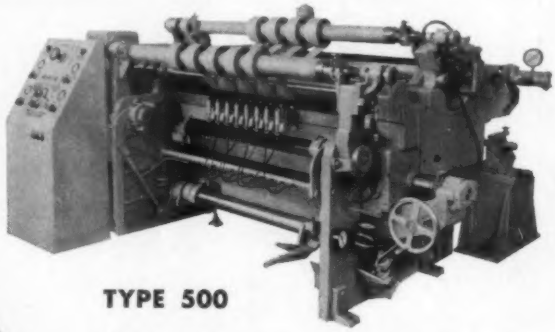
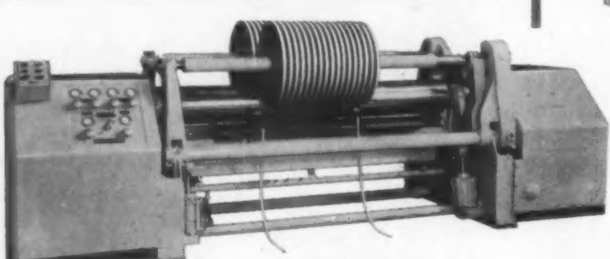


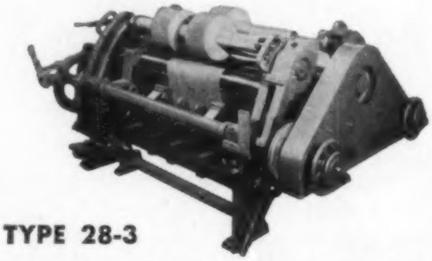
TYPE 500

A semi-automatic machine for top-quality rolls of light, heavy, stretchy or rigid plastics; laminates of all types; waxed or coated papers; foil; impregnated fabrics and other materials. Provides for quick changeover from one slitting method to another including score-cut, shear-cut, razor-cut, burst-cut, or SEALCUT for fusing. Rated at speeds up to 2000 fpm*.



TYPE 29-3

A high-speed, semi-automatic machine, with finger-tip controls for handling materials of uneven caliper, coated or tacky surfaced up to 1500 fpm*. Versatile in application to many types of materials.



TYPE 28-3

A popular, dependable machine especially suited for medium or heavy gauge plastic films. Provides choice of score-cut or shear-cut slitting. Rated at speeds up to 800 fpm*.

The Cameron line of slitter-rewinders includes several basic models, three of which are illustrated here. These three duplex machines feature combination surface and center rewinding. Other models are available with center rewind only. In every case the basic model selected is custom-fitted to the exact requirements of the user.

**Speed is dependent on machine width and character of products.*

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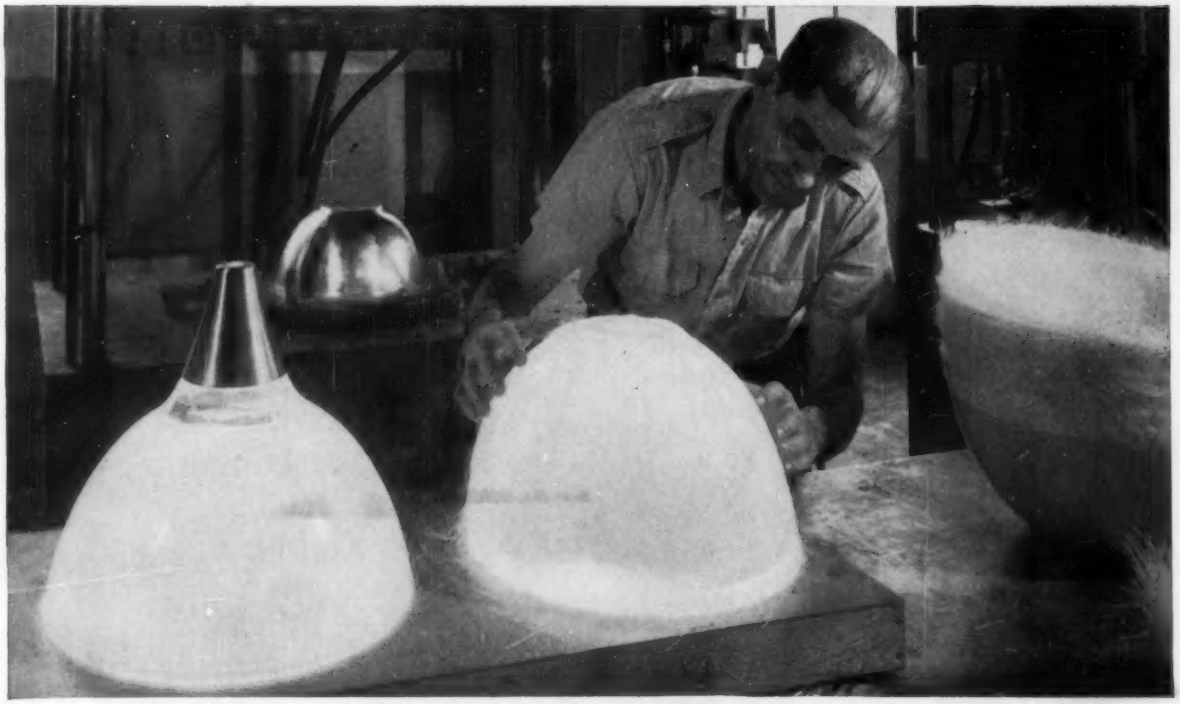

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Produced by the direct melt process under close control, Pittsburgh Fiber Glass is a top-quality, uniform reinforcement with many advantages for plastics manufacturers seeking uniform results in their finished products.

Pittsburgh Fiber Glass offers you exceptional strength, dimensional stability and dielectric strength; it is fire resistant, heat resistant and odorless.

. . . provides a complete range of reinforcements

ROVING—Pittsburgh Fiber Glass Roving gives you closer control over quantity of fiber glass in your product—assures product uniformity—speeds up production—can be packaged with uniform tension for better automatic feeding—can be supplied for either inside or outside drawing—variety of finishes and end counts available.

TYPE 508 ROVING—Pittsburgh Fiber Glass Type 508 Roving, in addition to general roving advantages, is free of static electricity under widely varying conditions of temperature and humidity during pre-forming operations.

CHOPPED STRAND—Pittsburgh Fiber Glass Chopped Strand is supplied in lengths of ¼" and up—packaged in corrugated cartons for convenient handling.

YARN—Pittsburgh Fiber Glass Yarns are supplied to weavers in all standard sizes—in any twist and ply—plain or with various binders.

. . . offers you technical assistance

Let us show you how Pittsburgh Fiber Glass can help you produce better plastic products. You can arrange to have free trials made with Pittsburgh Fiber Glass on your products right in your own plant by getting in touch with the Fiber Glass Division of Pittsburgh Plate Glass Company through its main office or any of the district sales offices. *Pittsburgh Plate Glass Company, Fiber Glass Division, One Gateway Center, Pittsburgh 22, Pennsylvania.*

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James E. Pratt, left, Socony Mobil engineer, obtains performance data on hydraulic system at an aluminum extrusion plant.
MORE ENGINEERS
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Specify Socony Mobil and get the services of more industrial lubrication engineers than are provided by any other oil company.
These specialists, working closely with your Mobil representative, will help you set up a plant-wide program of correct lubrication . . . advise on any lubrication problems that might arise. Their long experience and expert recommendations can improve your production and cut costs.
Socony Mobil products are also backed by *more* services for analyzing petroleum products in use . . . *more* on-the-job training of your personnel in correct product application . . . *more* approvals from machine builders . . . *more* continuous research to assure continually improved products . . . *more* practical experience—90 years!
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42

MODERN PLASTICS

Westinghouse
"Miracle Mile" Quality

BRIDGEPORT HELPS WESTINGHOUSE PRODUCE ADVANCED RADIOS AT THE FAMOUS METUCHEN PLANT

Incredibly complex machines . . . over 10 acres of electronic "day-after-tomorrow" manufacturing equipment . . . a production line over a mile long . . . combine to produce PRECISION-EERED television and radios like the models shown above! The last word in quality!

Bridgeport does their part — on advanced machinery and with modern production methods— to mold some of the intricate, durable plastic cabinets that play a role in Westinghouse performance. Not a step has been spared to make Westinghouse quality supreme in the industry.

Perhaps Bridgeport can help you produce superior products, too.

BRIDGEPORT MOULDED PRODUCTS, INC.

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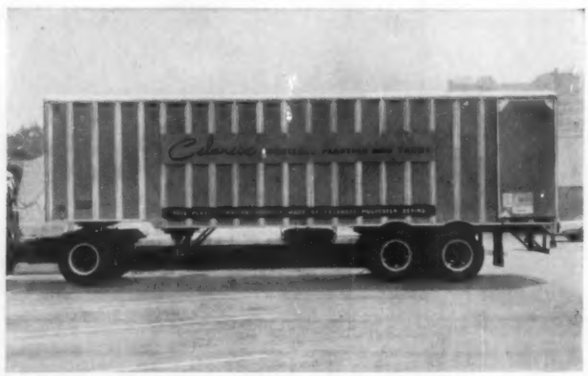
fast way to

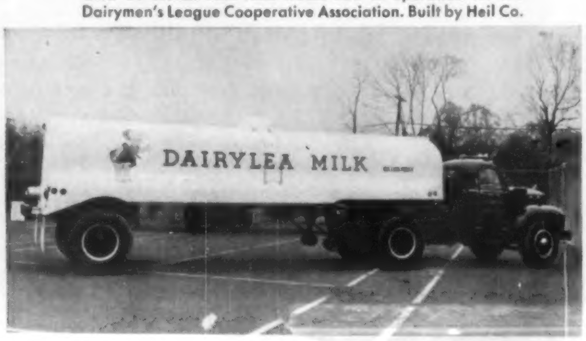
FRIGID-VAN manufactured by The Heil Co., Milwaukee, Wisconsin, from Celanese Marco resin. Superior insulation achieved by exclusive molding technique involving sandwich of reinforced plastic and rigid type insulation.



TRAILER VAN manufactured by Veenema & Wiegers Inc. using Amorex (The Englander Co., Inc., Baltimore, Md.) opaque side panels and translucent roof panel—one piece.

FARM PICK-UP TANK built by Heil Co. Produced by the Heil Frigid-Lite plastic method employing reinforced Celanese Marco resins.

ONE OF THREE milk tank trucks now in operation for the Dairymen's League Cooperative Association. Built by Heil Co.



INSULATED CHEMICAL TANK TRAILER built by the Heil Co. for T. I. McCormack Trucking Company, Inc., Woodbridge, N. J. Molded of reinforced Celanese Marco resins around stainless steel lining. Insulation provided by 3-4 inches of balsa wood between the shell and the jacket.

Mr. John T. Hildemann, McCormack V.P., states:

> "We have operated our 4200-gallon plastic transport on an average of 1400 miles per week since we took delivery last year. Payload increase has averaged better than two and one-half tons per trip—26,000 pounds per week!
>
> The superior insulating and thermal characteristics of this unit have saved us many man hours in unloading by keeping hot liquids such as waxes, oils and chemicals near the temperature at which they were loaded."

greater payloads

reinforced plastic construction with Celanese Marco Resins

The trucking industry is losing no time in taking advantage of the many benefits possible through plastic body construction. Here is what a truck body or trailer built of reinforced plastic can deliver: a body weight far lighter than conventional bodies—exchanging dead weight for greater payloads . . . resistance to weather, cold, heat, denting, moisture, stress, and vibration. Color may be permanently molded right into the material. Patch repairs can be made easily, quickly—on the road if necessary!

Celanese, producer of Marco polyester resins, has pioneered in the development of reinforced plastic construction for trucks, boats, furniture, architectural panels, and many other products. If any of the plastic truck bodies displayed on these pages suggest profit possibilities for you, you can get more complete information from a Celanese technical representative. Write: Celanese Corporation of America, Plastics Division, Dept. 11-K. 290 Ferry Street, Newark 5, N. J. Canadian affiliate, Canadian Chemical Co., Limited, Montreal, Toronto and Vancouver.

Export Sales: Amcel Company, Inc. and Pan Amcel Company, Inc., 180 Madison Avenue, New York 16, N. Y.

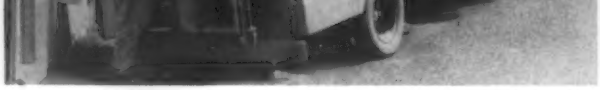
REFRIGERATOR TYPE truck manufactured by Veenema & Wiegers Inc., Paterson, New Jersey, for L & V Trucking Company. Phenolic impregnated paper honeycomb core between Celanese polyester laminated "skins" (The Englander Co., Inc., Baltimore, Md.) provides a high factor of insulation.

MAILSTER built by Cushman Motor Works Inc., Lincoln, Nebraska, for the United States Post Office for mail delivery in rural areas.

Celanese

plastics and resins

Celanese® Marco®



In sealing, potting and encapsulation—

EPON® RESINS

give excellent electrical, thermal and mechanical properties, plus—

- ✓ excellent dimensional stability
- ✓ high mechanical strength
- ✓ outstanding adhesion to metal, glass, plastics
- ✓ exceptional dielectric properties

Applying Epon resin sealing compound, formulated by Epoxylite Corporation, El Monte, California, to a 400-kva transformer winding at Larsen-Hogue Electric Co., Los Angeles, Calif.

Thoxene Clamp-Coat, an Epon resin cable splicing compound, produces a weatherproof, abrasion-resistant coating with high electrical insulation. Manufactured by Woodmont Products Inc., Huntingdon Valley, Pa.

Although relatively new, the Epon resins have won an important place in electronic and electrical manufacture. Their applications are manifold . . . in printed circuit laminates, transformer and motor sealing compounds, potting compounds for components and subassemblies, protective enamels, adhesives, tool and die materials.

For potting and encapsulating—the excellent dimensional stability of Epon resins, which can, for example, withstand solder bath temperatures without ill effect, and their outstanding adhesion to metals and glass assures airtight enclosure of delicate components and vacuum tubes

As adhesives—solvent-free Epon resin formulations cure at room temperature with contact pressure alone; form powerful bonds between glass, metal, wood or plastic.

As sealing compounds—varnishes and enamels based on Epon resins provide excellent moisture sealing plus outstanding resistance to solvents and chemicals, even at elevated temperatures.

For laminating—Epon resins laid up with inert fibrous fillers produce base laminates that have superior dielectric properties and can be sheared, punched, drilled and bath soldered.

Write for information on the use of Epon resins in electrical and electronic applications.

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The Plastiscope* November 1956

News and interpretations of the news

By R. L. Van Boskirk

Section 1

Polystyrene prices and sales figures. Several correspondents have commented on the paragraph relating to polystyrene in this column last month. To set the record straight, the price of general-purpose polystyrene crystal was reduced 3¢—is now 27½¢ a lb. in 20,000-lb. lots or more. There is no longer an advantage in buying 80,000-lb. lots. Impact styrene, natural color, is 32¢; colors are 34½ cents. Super-impact did not change; it is still 38½¢ for natural and 42½¢ for colored. The styrene-acrylonitrile molding powders are 40½¢ in natural and 43½¢ in color. A year ago they were 45 cents.

There is also a consensus that the invasion of polyethylene into the polystyrene field had little, if anything, to do with the recent price drop. That invasion has been going on gradually for a year or so and had little to do with the 10 million-lb. drop in polystyrene sales volume in June. That drop may well have been the result of the earlier 1½¢ price increase announced in April. At that time producers gave advance notice of the raise and molders filled their inventories in April and May. Consequently, their purchases were low in June. July bounced back up to over 27 million lb. compared with 25 million in July 1955; August 1956 should go over August 1955's 31 million pounds. First-half sales of polystyrene in 1956 were 209 million lb. compared to about 190 million in 1955. Exports, included in the total figures given above, are now running from 4.5 to over 6 million lb. a month.

More acetylene in Texas area. Diamond Alkali Co., Cleveland, Ohio, has announced plans for constructing a multi-million dollar facility for manufacturing acetylene at its Deer Park plant in Houston, Texas. The plant is announced as part of a plan to coordinate the growing productive capacity of the firm's polyvinyl chloride resin plant at Deer Park as well as to contribute toward more national production of "this major organic chemical building block." Production capacity of the new facility has not been announced.

Consumption of acetylene in 1954 was around 600 million lb., of which 340 million lb. went to chemicals, including the approximately 100 million lb. used for vinyl chloride. The trend to acetylene for vinyl is increasing after a few years during which it looked as though the favored route might be through ethylene. The Diamond acetylene will be made from gas—only 15% of today's production stems from that source.

Diamond says its acetylene plant is part of the company's \$60 to \$80 million expansion program that should result in sales volume of \$160 to \$180 million by 1960. The program includes doubling capacity of its present vinyl

* Reg. U.S. Pat. Off.

chlorine resin plant where present capacity is estimated at around 25 million pounds. The new vinyl facilities will be on stream in the first half of 1957. The company is also interested in "a hopeful new plastics polymer from cheap and plentiful raw materials which may open new vistas."

Another Teflon broadens the range. A new Teflon, called 100-X perfluorocarbon resin, has been developed by Du Pont. It approaches the unique heat and chemical resistance of conventional Teflon but can be extruded in conventional equipment because of its low melt viscosity. Ordinary Teflon requires special equipment. The generic term "perfluorocarbon" has been adopted to distinguish it from conventional Teflon, but it is a true fluorocarbon consisting entirely of fluorine and carbon. It is expected to broaden the range of fluorocarbon uses in applications not previously attempted because of processing difficulty. In the laboratory, it has even been extruded into film on conventional equipment. There seems to be a possibility that it may even be injection molded. The material will be in ⅛-in. pellets instead of in fine powder like conventional Teflon.

However, there will be no commercial production until 1959 or later. A pilot plant is just now under construction. But premature information concerning the material leaked out and Du Pont therefore released knowledgeable details while emphasizing that the material is not yet available.

Patent issued for urethane foam production. Patent No. 2,764,565 was issued by the United States Patent Office in the names of three associates of Farbenfabriken-Bayer A.G., Leverkusen, Germany. Mobay Chemical Co., a joint venture of Monsanto Chemical Co. and the Bayer firm, has control of the patent in this country. The patent covers an injection technique used in the manufacture of urethane products to permit quality control of the process as the chemical ingredients are blended and mixed under pressure.

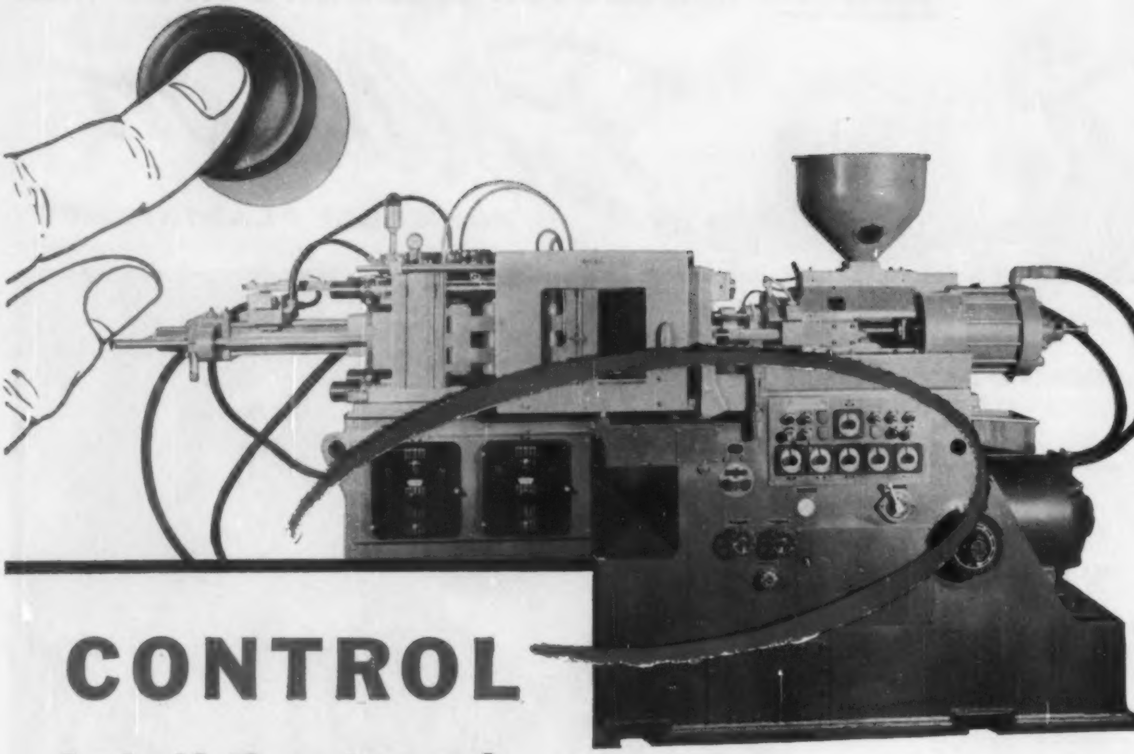
Basically, the patent covers a method whereby a polyester resin stream comes into the mixing chamber from a gear pump or other positive action pump, and other ingredients, including water, are injected into the polyester or prepolymer stream under high pressure in the mixing chamber. Claims of the patent are said to be much broader than other patents on the subject. The principle covered by this patent can be used to produce molded items such as crash pads and seat cushions.

The prepolymer is an isocyanate-polyester combination in which no water and a smaller than usual amount of isocyanate is contained. It will remain stable for from two days to three months, depending upon the content. When water and an activator are added, polymerization takes place.

How about that polyester figure for reinforced plastics? The polyester figure for reinforced plastics in Tariff Commission reports is most confusing. The sales volume for polyesters reported in 1955 was 52 million lb., but there is no certainty of how much was for reinforced plastics. If present trends continue, the sales volume will be around 65 million lb. in 1956.

There are many kinds of polyesters and apparently the manufacturers of such resins report to the government in a highly variable fashion. The styrene-type polyester is supposed to be the only one used for reinforced plastics, except for a small amount of diallyl phthalate type. Yet the total listed for styrene-type polyester in 1955 was only 27 million lb.—"all other polyesters" were reported as 25 million pounds. But analysts can't account for

(To page 53)



The Plastiscope

(Continued from p. 50)

that amount of polyester resins in "all other." Polyester for Mylar is reported in another classification, so it can't be in this tabulation. Adipic acid-type polyesters for urethane are growing but couldn't have been much over 1 or 2 million lb. in 1955. The polyesters used for buttons don't seem to be listed anywhere. Polyesters used in vinyl plasticizers are reported in another classification. Styrene alkyds for protective coatings are reported elsewhere. So, outside of a few odds and ends such as sebacic acid variations, where does that 25 million lb. figure come from?

Perhaps the answer comes from the list of producers listed as manufacturers of "all other than styrene-type polyesters" in the Tariff Commission report. There are several companies which report in both classifications, but it may be significant to note that such producers as General Tire, Pittsburgh Plate Glass, Celanese, Naugatuck, and Hooker are listed only in the "all other than styrene type" classification. All these companies are large-scale producers of polyesters for reinforced plastics. Many smaller companies which are primarily paint resin producers are also listed in the "all other" classification. It seems obvious then that the 27 million lb. listed as styrene-type polyesters by no means covers the total amount of polyester resin for reinforced plastics. But it is also obvious that the total polyester resin sales figure is no fair criterion for measuring reinforced plastics.

Union Carbide acquires Visking. In a very brief press release which gave no details, Union Carbide and Carbon Corp. stated that the firm had agreed to acquire all of the business and assets of Visking on a basis that will provide to the stockholders of Visking one share of Union Carbide stock for each 2½ shares of Visking. Completion of the transaction requires approval of Visking stockholders, and until that is obtained there will be no word from Carbide concerning details on its plans.

If the transaction goes through, it could prove to be one of the most significant factors in the development history of polyethylene film, especially since an ever-intensifying competitive situation is expected to reach a climax in 1957 or 1958. Visking is generally credited with producing well over half of all the polyethylene film manufactured in the United States, and as volume of sales increased, has consistently lowered the price.

Competition in polyethylene film industry. The competitive angle in polyethylene film is sharpening quite noticeably, spurred on by the entrance of more film producers and the ability of more polyethylene producers to make a suitable film-grade resin. Estimated production of polyethylene film this year is somewhere between 135 and 145 million lb., compared with around 120 last year—a good poundage gain but at a lower ratio than in past years. Complainants assert that the reason is low profit—both film producers and packaging film converters state that profits are so negligible that there is little sense in going after more

business. Whether or not the proposed Carbide-Visking merger will help this situation is problematical, but it might be listed as a "girding of the loins" in preparation for future developments.

It may be that both Visking and Carbide management saw a threat in the growing trend toward integration of producer, distributor, and processor—and moved accordingly to meet such competition. Rumors have been rampant concerning a possible Visking tie-up with a resin producer for over a year, but not many persons spotted Carbide as the buyer even though Bakelite, a Div. of Union Carbide, has been Visking's principal supplier down through the years. The Koppers purchase of Durethene (a large film producer) some months ago may have been the spark that really touched off integration in this industry. Another combination not yet publicized is that of a resin producer, a nationwide merchandiser and distributor, and a western extrusion firm. Such a three-way organization, if completed, could indeed be formidable. Names can't be used here, for there is as yet no confirmation of this arrangement. And then there are various captive polyethylene film plants that are controlled or owned by huge corporations which are well able to withstand the rigors of vigorous competition and the burden of heavy financing. Obviously, the largest film producer and largest resin producer wouldn't let all these challenges go unnoticed.

Isocyanate price reduction. A 50% price reduction for Nacconate 300 (MDI diisocyanate) from $3.50 to $1.75 per lb. has been announced by National Aniline Div., Allied Chemical & Dye Corp. A similar price reduction applies to the material when furnished as a 50% solution in o-dichlorobenzene, for which the price now is $1 per pound. These are the types of isocyanate used in adhesives and for various purposes in the rubber industry. The adhesive producers have been itchy to get their hands on more isocyanate at a lower price for a long time. It has long been recognized as a superior ingredient for many types of adhesives, but cost was a great handicap.

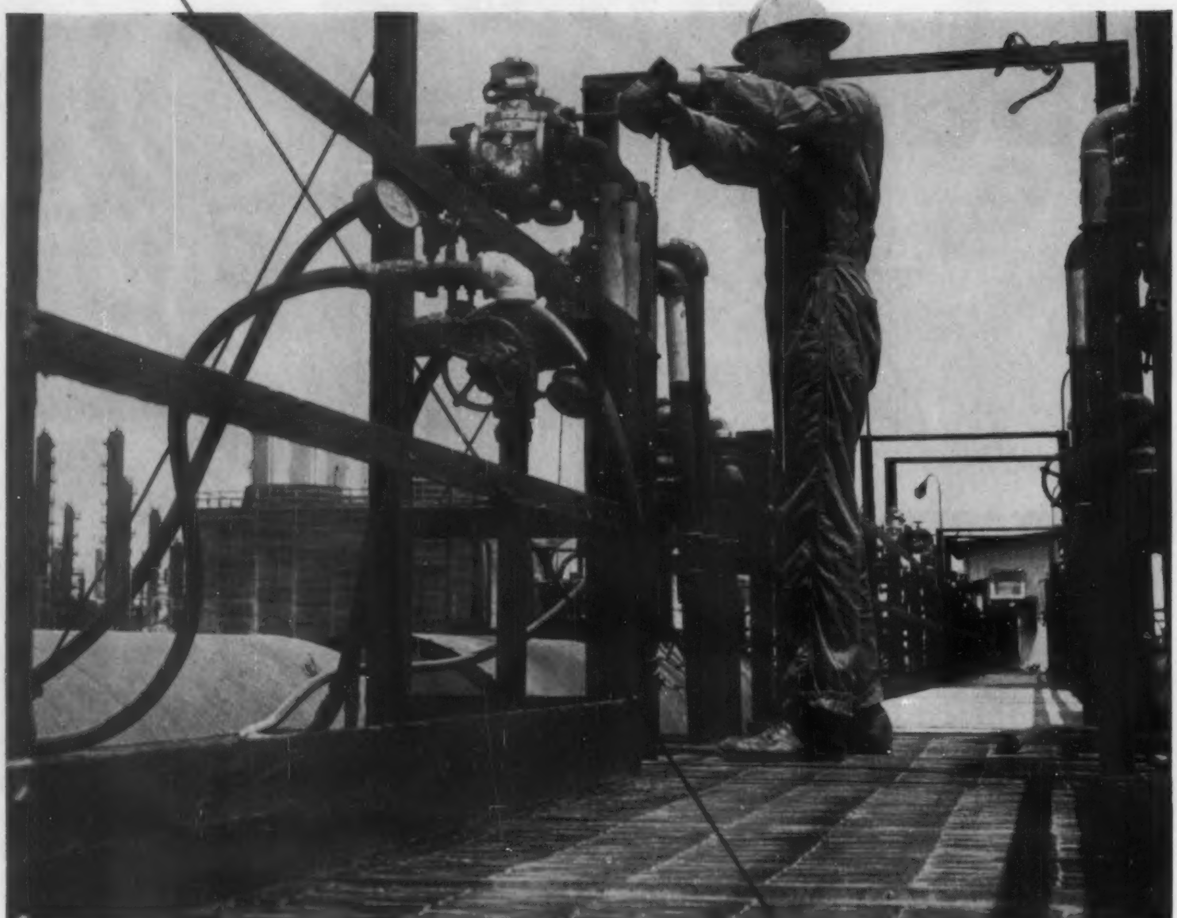
The price reduction for adhesive-type isocyanate follows closely a recent price reduction to 95¢ a lb. for Nacconate 80, which is used for foam. National's new plant for isocyanate production at Moundsville, W. Va., is expected to come into production this month (November). Past deliveries were made from an interim plant at the Buffalo facilities.

Polyesters from citric acid. Successful production of polyester resins from citric acid has been reported to the American Chemical Society by Dr. Charles J. Knuth of Chas. Pfizer & Co., Inc. The base resin described was prepared by chemically combining the citric acid first with glycol and then with allyl alcohol. Peroxide catalysts were among the agents used to cure the new group of resins. Citrate polyesters can also be copolymerized with vinyl acetate, methyl methacrylate, or triallyl citrate.

Vinyl film for foodstuffs. Harte & Co. has introduced a new vinyl chloride film that can be safely used with foodstuffs without trace of odor pick-up. Named Wataseal FD-27, it is non-toxic and has been accepted by the U. S. Food and Drug Administration as a safe packaging material for food and beverages. Foods such as lard, margarine, butter, bacon, fruits, and vegetables, which contain a large amount of water, can be packaged in this film without drying out.

For additional and more detailed news see Section 2, starting on p. 262.

yet to be exploited

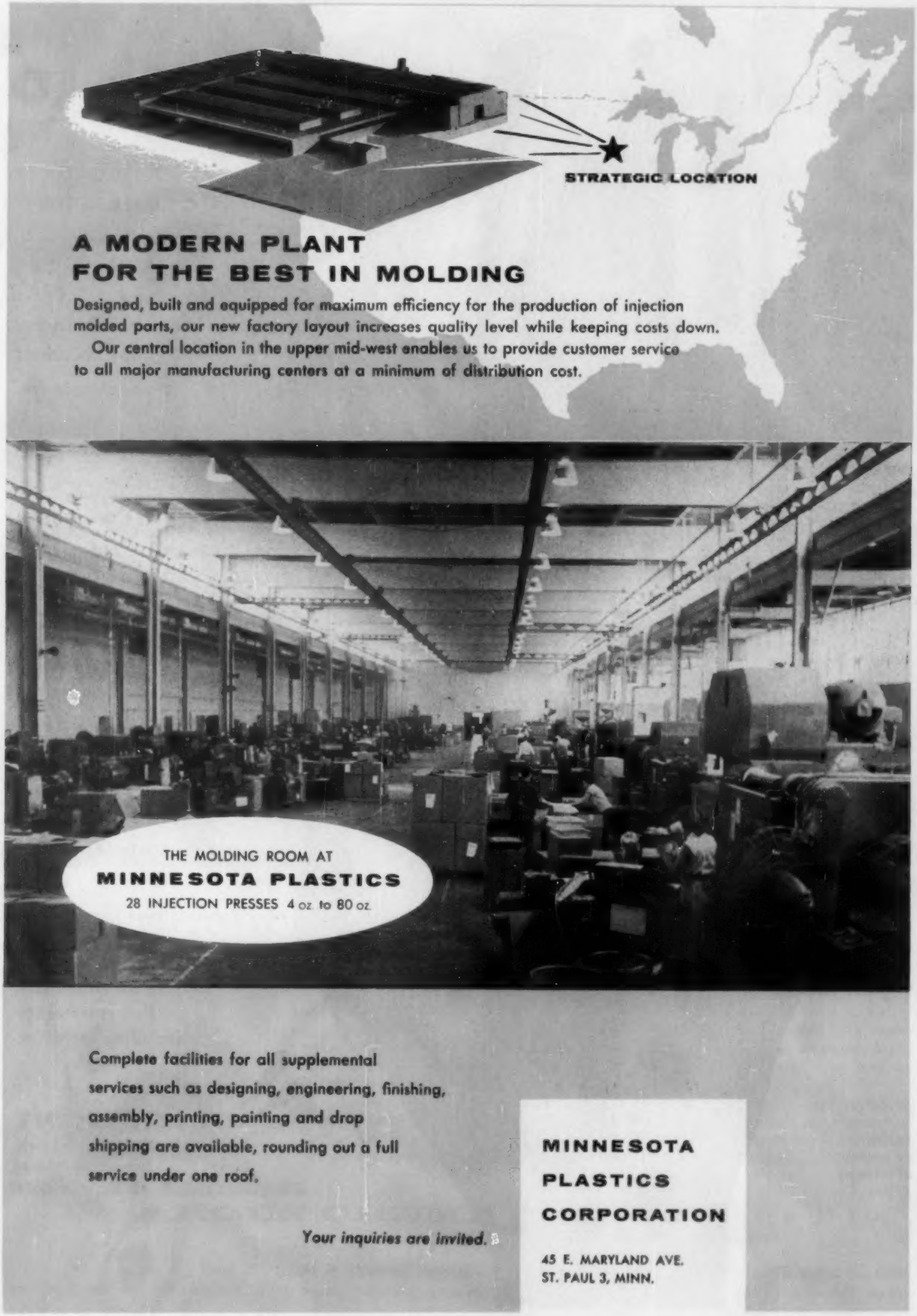


Butadiene and its derivatives can be the basis of a wide range of better plastics, films, adhesives, elastomers, etc. Soon this unsaturated monomer will be amply available commercially at an attractive price. Many new products that have been researched can now be exploited.

With additional butadiene capacity now being installed, we invite discussion of your future needs and our unique abilities to supply them.

Petro-Tex

PETRO-TEX CHEMICAL CORPORATION
HOUSTON 1, TEXAS
A JOINT ENTERPRISE OF
TENNESSEE GAS TRANSMISSION COMPANY AND FOOD MACHINERY AND CHEMICAL CORPORATION


STRATEGIC LOCATION
A MODERN PLANT
FOR THE BEST IN MOLDING
Designed, built and equipped for maximum efficiency for the production of injection molded parts, our new factory layout increases quality level while keeping costs down.
Our central location in the upper mid-west enables us to provide customer service to all major manufacturing centers at a minimum of distribution cost.
THE MOLDING ROOM AT
MINNESOTA PLASTICS
28 INJECTION PRESSES 4 oz to 80 oz
Complete facilities for all supplemental services such as designing, engineering, finishing, assembly, printing, painting and drop shipping are available, rounding out a full service under one roof.
Your inquiries are invited.
MINNESOTA
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CORPORATION
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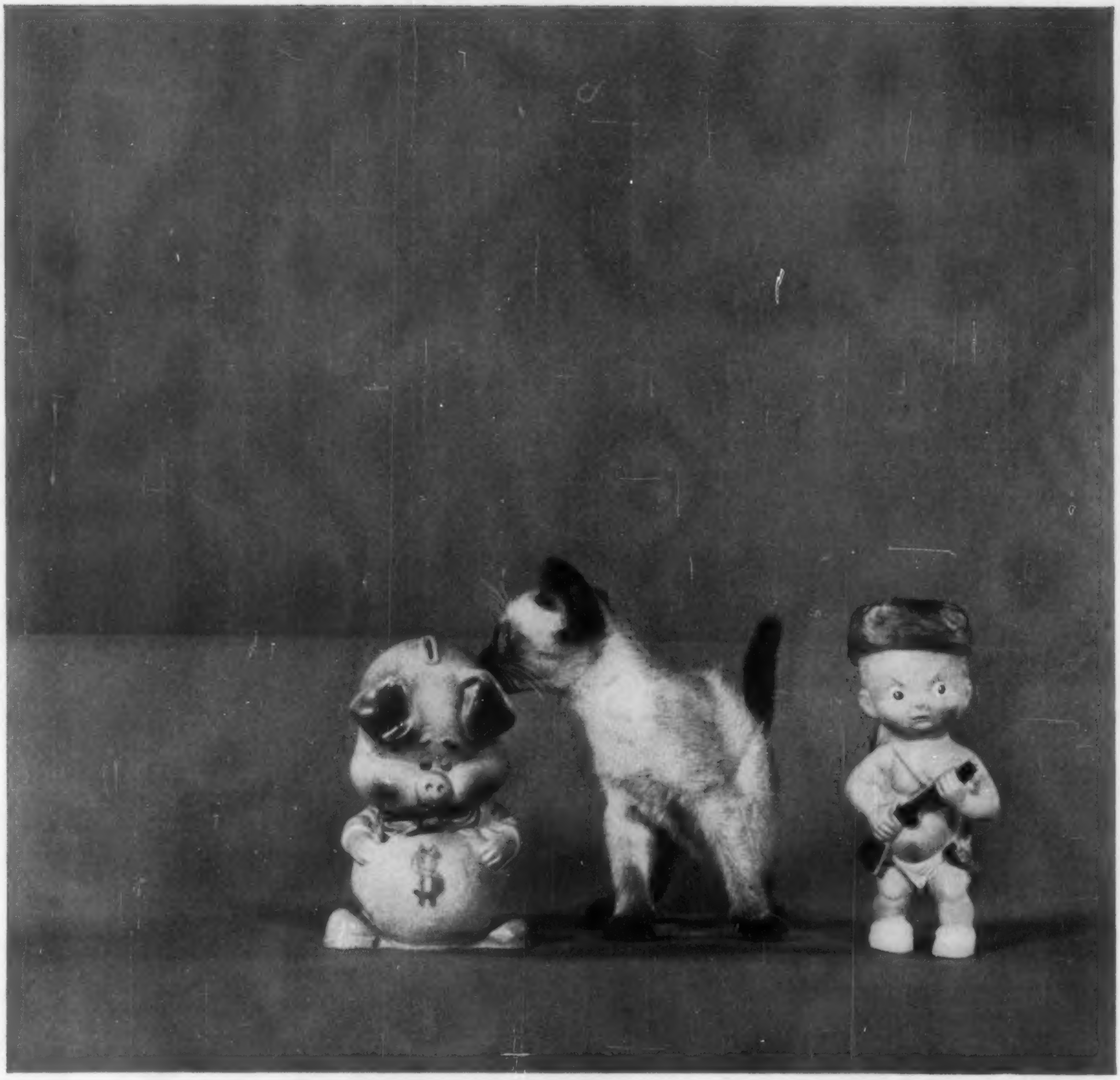
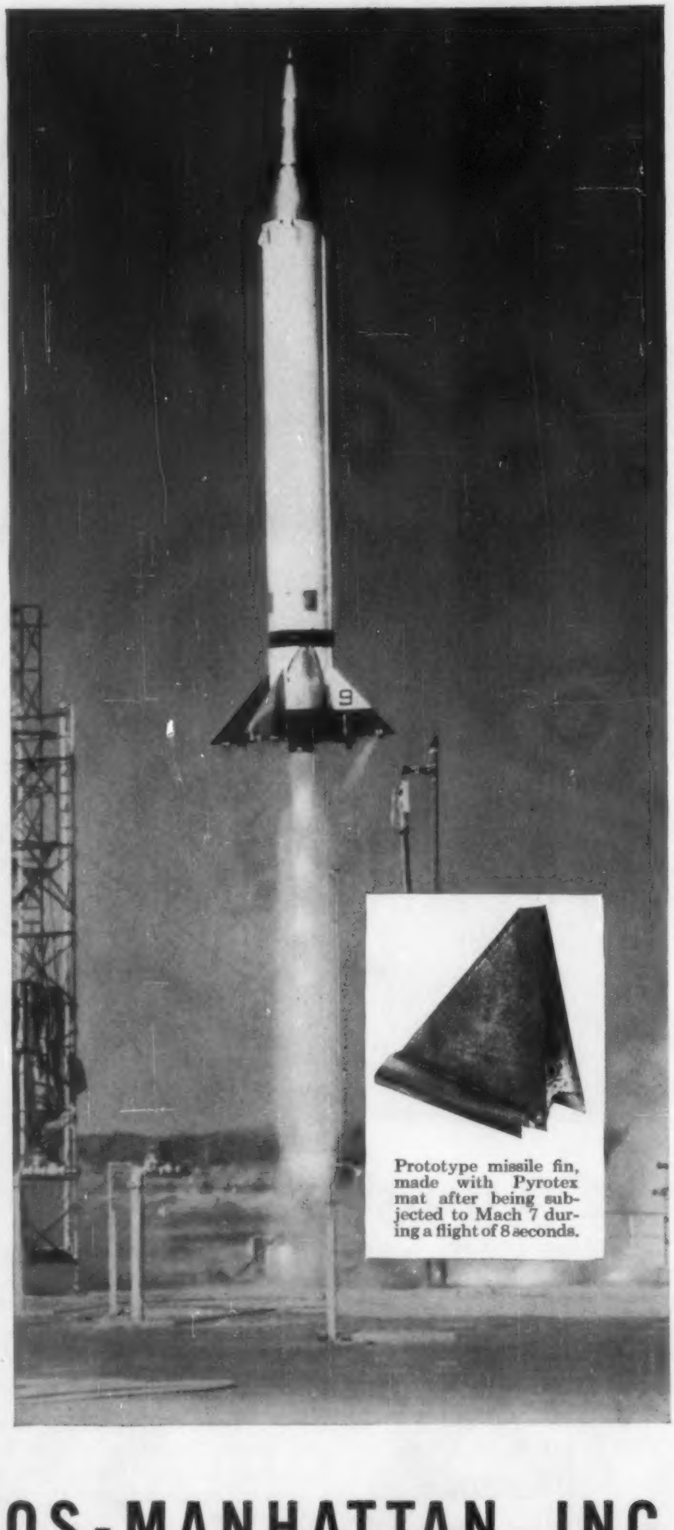


WANTED:
A low-cost missile fin to take Mach 7



Prototype missile fin, made with Pyrotex mat after being subjected to Mach 7 during a flight of 8 seconds.

PROBLEM:
Riding on the back of a rocket that is traveling many times the speed of sound, fins take a terrific beating from the heat generated by air friction. Even during a flight of comparatively few seconds, the temperatures may go as high as several thousand degrees Fahrenheit. Not only must the materials withstand the heat, but they must maintain their strength and smoothness.

SOLUTION:
Missile designers find that R/M Pyrotex Felts and Mats give superb results when used in fabricating fins, stabilizers and bodies. For example, Pyrotex fins have been subjected to temperatures of 3000°F for periods of from a few seconds to several minutes. Shown here is a missile fin tested at Mach 7.

If your design demands *all* of the following features, find out more about the new family of R/M reinforced plastics (felts, mats, papers and molding compounds).

1. Excellent resistance to heat and flame
2. High modulus of elasticity from low to high temperatures
3. High strength from low to high temperatures
4. Smooth, abrasion-resistant surfaces
5. Exceptional dimensional stability
6. Elimination or reduction of surface crazing of resins
7. Good insulation and thermal properties
8. Economical to fabricate

For further information, please write for technical bulletins

R/M

RAYBESTOS-MANHATTAN, INC.
ASBESTOS TEXTILE DIVISION, MANHEIM, PA.

FACTORIES: Manheim, Pa.; Bridgeport, Conn.; No. Charleston, S.C.; Passaic, N.J.; Neenah, Wis.; Crawfordsville, Ind.; Peterborough, Ontario, Canada

RAYBESTOS-MANHATTAN, INC., Asbestos Textiles • Laundry Pads and Covers • Packings • Brake Linings • Brake Blocks • Clutch Facings • Fan Belts • Radiator Hose Rubber Covered Equipment • Industrial Rubber, Engineered Plastic, and Sintered Metal Products • Abrasive and Diamond Wheels • Bowling Balls

MINI-JECTOR

TRADE MARK

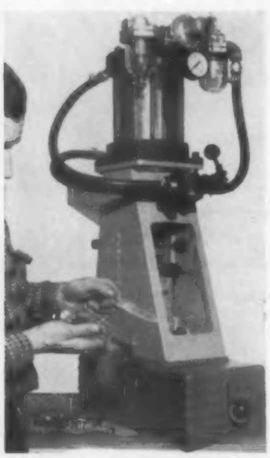
PLASTIC INJECTION MOLDING MACHINES

THERE IS A MINI-JECTOR MADE TO SOLVE YOUR SMALL CAPACITY (1/3 oz. to 1 oz.) INJECTION MOLDING PROBLEMS

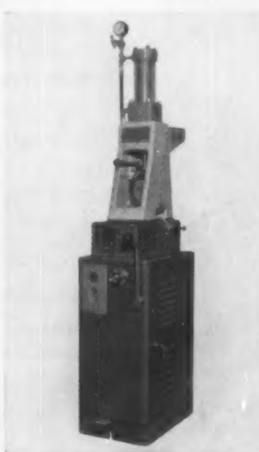
Here are the small thermoplastic injection molding machines that do a small job in a big way! Economical to operate and low in cost, these up to 1 ounce plastic injection molding machines are turning out thousands of small plastic items every day for hundreds of satisfied users. Molds any thermoplastic . . . including Nylon. The Mini-Jectors are the most versatile machines in their class. Simple and compact in design, Mini-Jectors operate easily and efficiently and owners everywhere find they pay for themselves many times over.

MODEL 60-PC 75 "HORNET" POWER OPERATED LEVER CONTROLLED. Mold size 6" x 5" x 5 1/8"

This model retains all of the time-tested features of our popular 60-HC75 with the added feature of hydraulically operated, lever controlled mold opening and closing for faster, easier production. Like all Mini-Jectors the 60-PC75 gives you the most economical way of injection molding articles in the capacity range of 1/3 oz. to 1 oz., where modest scale production is required.



MODEL 45 "WASP" 3/4 oz. capacity air-operated Mini-Jector . . . fast and economical. 6" air cylinder operates ram . . . 40 to 150 pounds of air pressure required depending on type of plastic used and product being molded. Material hopper capacity 4 pounds.



MODEL 50 "WASP" a new Mini Jector . . . capacity 1/3 oz. to 1 *OUNCE* at pressures up to 30,000 PSI. This is an ideal model for precision insert work with any type of plastic. Hydraulically operated.

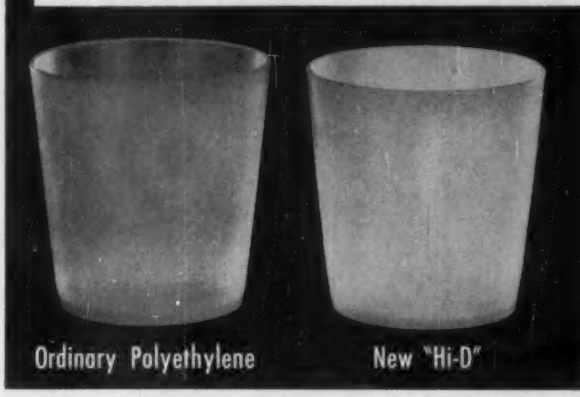
EVERY DAY THOUSANDS OF ITEMS ARE BEING PRODUCED PROFITABLY ON MINI-JECTORS

WRITE TODAY . . . for literature telling how Mini-Jector may help solve your injection molding problems, to . . .

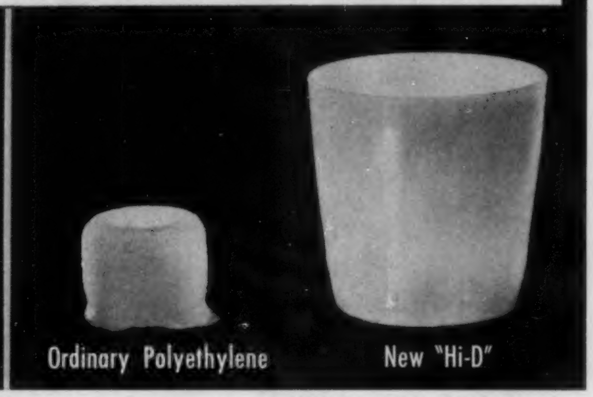
NEWBURY INDUSTRIES, Box 87, Newbury, Ohio

"Specializing in the Production and Development of Plastic Injection Molding Machines up to one ounce capacity."

New "Poly-Eth Hi-D" by Spencer survives oven test that melts ordinary polyethylene:



(1) Before going into oven these two polyethylene cups look alike. Cup at left is made from standard polyethylene. Cup at right is Spencer Chemical Company's new high density polyethylene "Poly-Eth Hi-D."



(2) After 30 minutes at 240°F. the ordinary polyethylene cup has melted down; the "Hi-D" cup has retained its shape. This means you can use "Hi-D" for products subject to temperatures of boiling water and higher.

Spencer Chemical Company leads the industry with

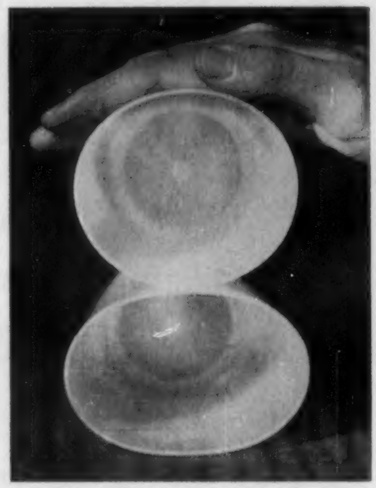
New Hi-Density "Poly-Eth" In Commercial Quantities

Countless new uses for polyethylene have been made possible by Spencer Chemical Company's introduction of a new high density polyethylene molding resin produced in a high-pressure type plant. Developed by Spencer's own staff, this new resin, trademarked "Poly-Eth Hi-D," has a density ranging from .935 to .940, and is non-toxic and odorless. Spencer is the first domestic producer to offer resins in this high density in commercial quantities.

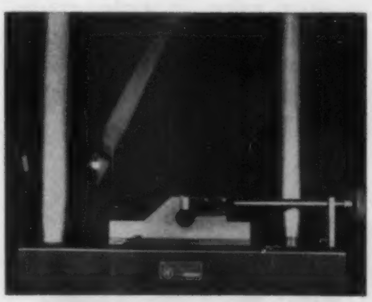
Here are just a few of the unique properties of "Poly-Fth Hi-D" compared with standard or intermediate density polyethylene: (1) Higher heat resistance — easily withstands boiling water without deformation; (2) Improved stiffness and rigidity—permits, in some cases, a money-saving reduction in wall thickness without loss in strength; (3) Less permeable.

Faster cycling periods should be possible with "Poly-Eth Hi-D," since these resins can be taken from the mold at higher temperature. And products molded from "Poly-Eth Hi-D" will have improved resistance to surface abrasion.

Only Spencer offers you commercial quantities of this new polyethylene. So for more information, contact your nearest Spencer sales representative, or write Spencer Chemical Company for a "Poly-Eth Hi-D" data sheet.



(3) New "Hi-D" (top) is stiffer, too, than standard polyethylene (bottom cup). Yet "Poly-Eth Hi-D" has the same fine impact properties associated with conventional polyethylenes.



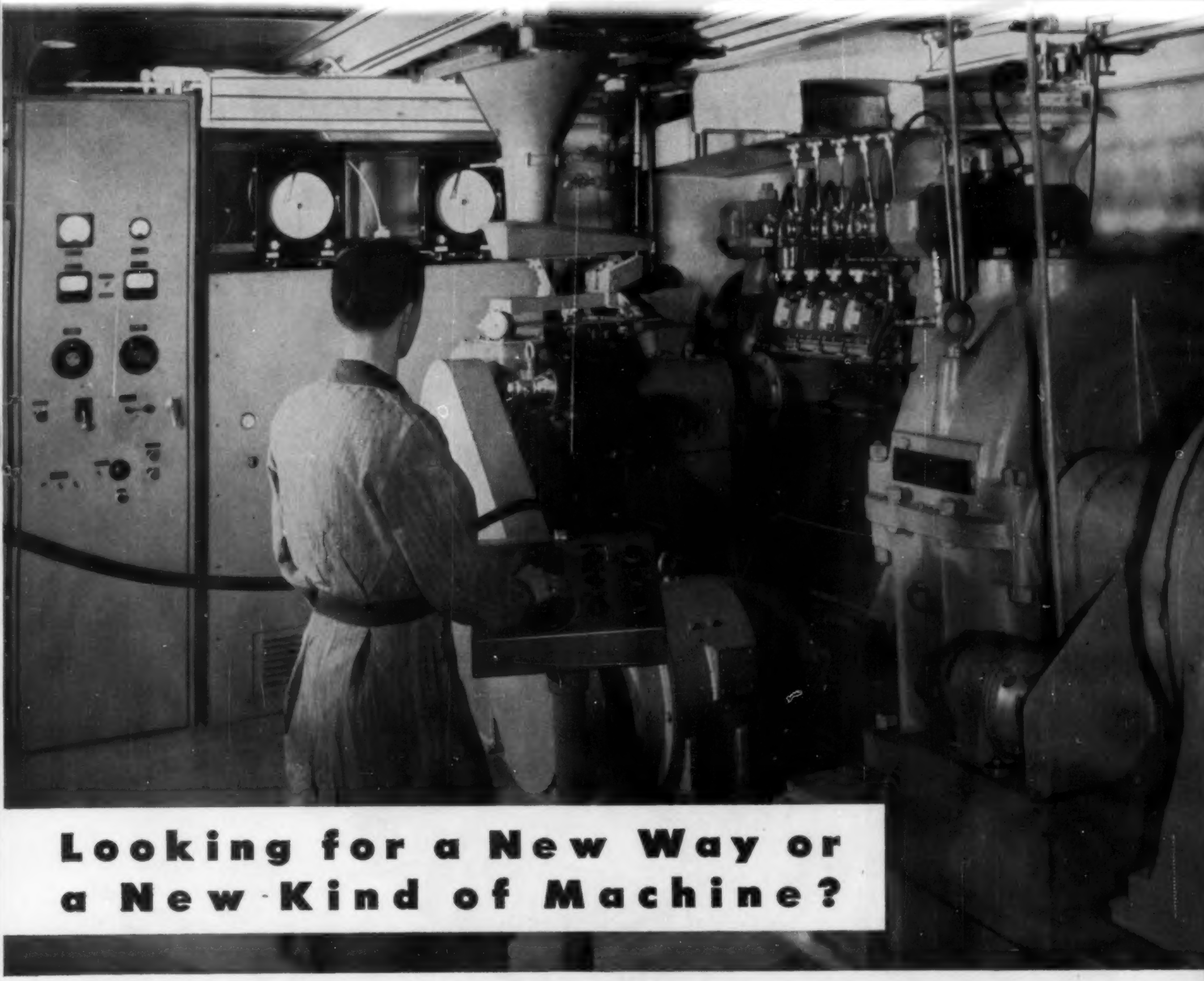
(4) Low-pressure type polyethylene snaps after impact with pendulum hammer in Izod notched impact test. The broken half is at the extreme left in this high-speed photograph.

(5) "Hi-D" withstands this same severe test. The sample has not broken and is rebounding into normal position. Think of the ways you could use this new polyethylene.

Poly-Eth Hi-D

SPENCER

SPENCER CHEMICAL COMPANY
Dwight Bldg., Kansas City 5, Mo.



DIME OR DOLLAR SIZE...

ROLL - DISPENSED

Pressure-Sensitive LABELS

YOUR Roll Label Printer is a specialist in this field. His specialized "know-how" is based on years of experience and study in connection with designing and printing *labels that sell!*

He prints on KLEEN-STIK pressure-sensitive paper stock, using specially-built equipment, to provide you with labels that will keep your production lines rolling at top speed. Practically any size . . . any shape . . . any stock — for fast, easy application without the use of water, glue or heat. For low-cost, high-impact labeling on your product or package, see your Roll Label Printer.

direct from the ROLL LABEL SPECIALIST of your choice

FREE! TEST-IT-YOURSELF KIT

Contains a selection of pressure-sensitive samples for on-the-spot testing in your own plant. Write today!

Pressure-sensitive roll labels in specially designed dispensers give you the *world's fastest known* method of hand labeling. Available through your Roll Label Printer in automatic, semi-automatic, or hand-operated models to suit every need.

KLEEN-STIK PRODUCTS, INC.

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Pioneers in Pressure Sensitives for Advertising and Labeling

why key parts are molded from Gering's thoroughly compounded formulations!

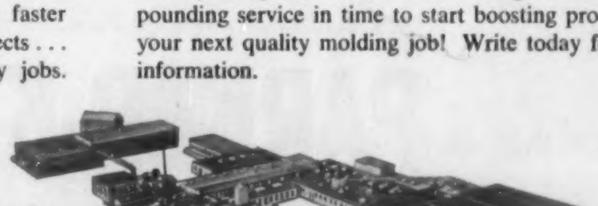
They're long-lasting, eye-catching, durable beauties for the youngest post-diaper set . . . and there's a mighty good reason why Gering polyethylene formulations went into production of these toys!

For the molder gains much more than sure color matching and dependable quality. Gering custom compounded polyethylene gives the molder faster production cycles, easier mold release, less rejects . . . all adding up to low costs for high quality jobs.

Gering custom compounds *all* thermoplastics for extrusion and injection molding . . . special or standard formulations, varied colors and special effects. All developed to your needs by Gering technicians . . . delivered to your shop ready to mold!

Why not get all the facts on Gering custom compounding service in time to start boosting profits on your next quality molding job! Write today for full information.

GERING

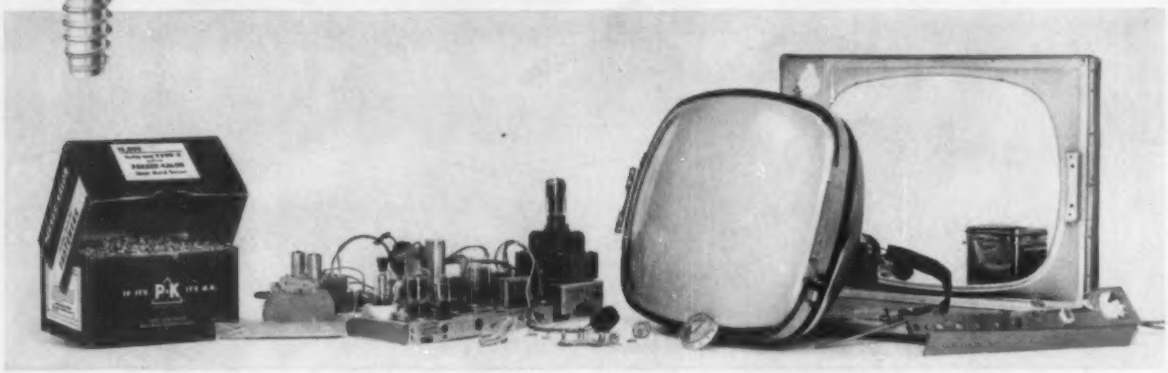


PRODUCTS INC.

KENILWORTH, N. J.

Pioneers in modern plastics for over 30 years!

P-K® screws help Motorola



put together assembly savings

How designers and production men work hand in hand to keep production up . . . assembly costs down

To keep production high and costs low, Motorola designers specify the best fasteners that can be bought—Parker-Kalon Self-tapping Screws. They know that *the price paid for fasteners is but a small fraction of the cost of using those fasteners in production.* Because P-K Self-tapping Screws consistently start right . . . drive right . . . and stay tight, Motorola guards against assembly slowdowns and costly salvaging of damaged parts.

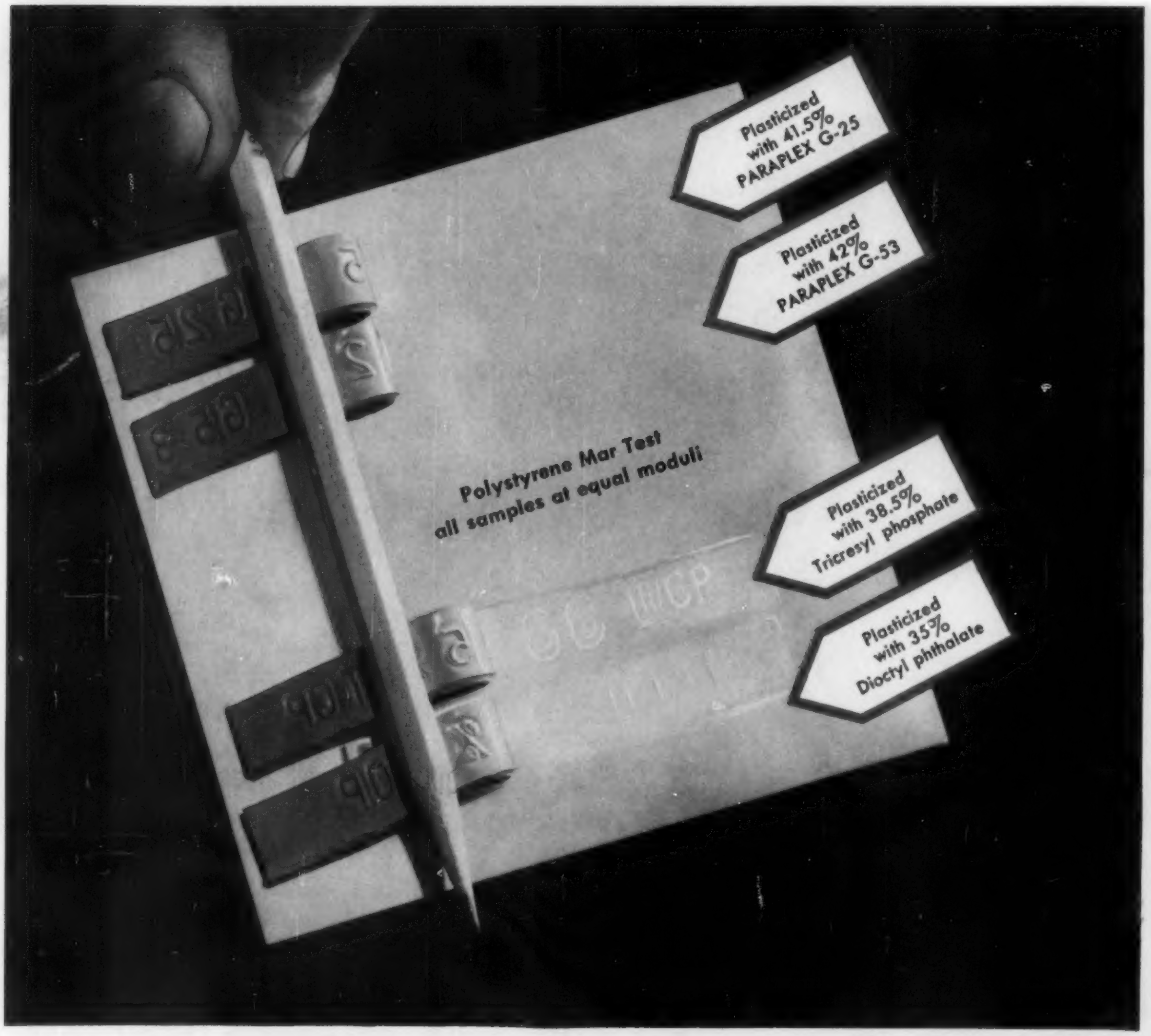
This example is typical of thousands of cases where designers help production men turn out a better product *faster*—and at less cost—by specifying P-K Self-tapping Screws. This simple fact is being proved day after day . . . "if it's P-K, it's O.K."

PARKER-KALON DIVISION, General American Transportation Corporation

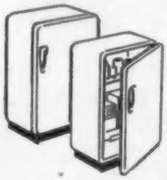
PARKER-KALON®
fasteners

Sold Everywhere Through Leading Industrial Distributors

Factory: Clifton, New Jersey—Warehouses: Chicago, Illinois—Los Angeles, California



Cut down plasticizer migration with PARAPLEX G-53



The test illustrated here clearly shows why polymeric plasticizers such as PARAPLEX G-25 and PARAPLEX G-53 are recommended for use in vinyl compounds which contact polystyrene, lacquers, rubber, and baked finishes.

Take polystyrene for example. Widely used in refrigerators and other appliances, polystyrene is often severely marred by vinyl gaskets containing so-called fugitive plasticizers. When PARAPLEX G-25 or PARAPLEX G-53 is used, migration is drastically reduced and the appearance and physical properties of the polystyrene are virtually unaltered.

PARAPLEX plasticizers provide many other benefits, too. PARAPLEX G-53 is highly resistant to extraction by soaps, detergents, and hydrocarbons. It is extremely non-volatile. And its cost is quite moderate. High molecular-weight PARAPLEX G-25 has all of the physical properties of PARAPLEX G-53—and more.

For more information on *all* of the plasticizers produced by Rohm & Haas Company, ask for *What You Should Know About* PARAPLEX *and* MONOPLEX *Plasticizers*.

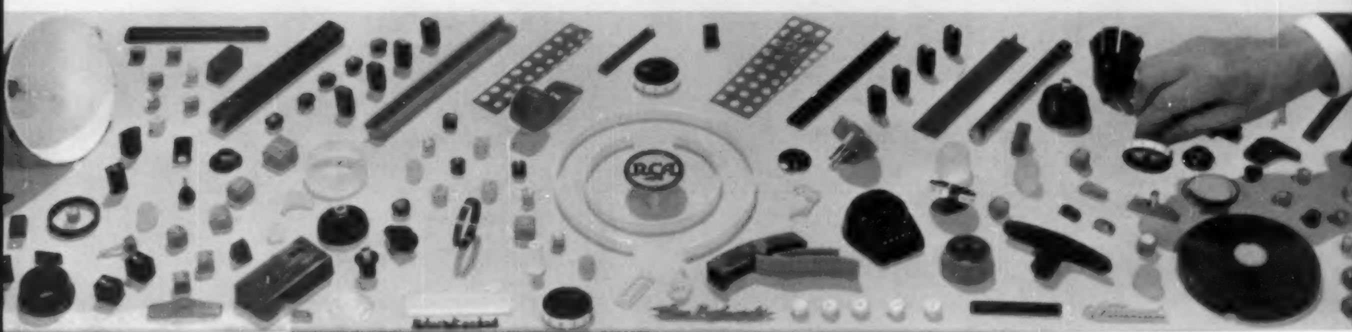
PARAPLEX *and* MONOPLEX *are trademarks, Reg. U.S. Pat. Off. and in principal foreign countries.*

Chemicals for Industry

ROHM & HAAS COMPANY

THE RESINOUS PRODUCTS DIVISION
Washington Square, Philadelphia 5, Pa.

Representatives in principal foreign countries


RCA

Why use this much heat

when this is all you need?

See the difference . . . save the difference

with CHROMALOX

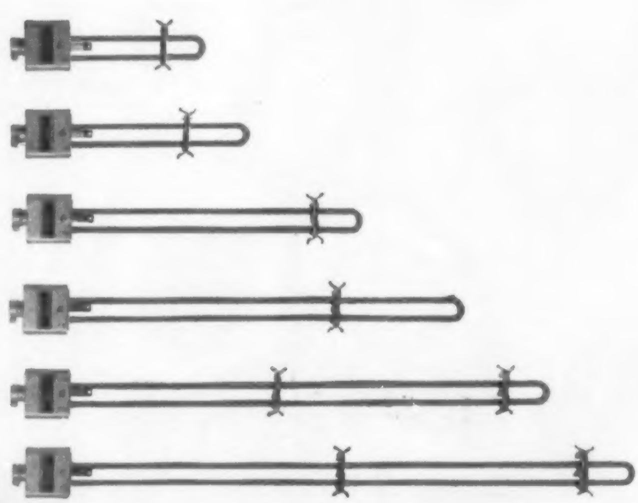
adjustable-area Far-Infrared Heaters

The new Chromalox URAD heater lets you match your heat source to your work size, in vacuum forming, embossing, resin finishing and curing, vinyl fusing, and post forming operations. Into one basic housing you can install up to 27 different heated lengths, which can be varied with the size of the work.

You can do-it-yourself too. Chromalox Far-Infrared elements are designed with a sliding fit that lets you interchange elements anywhere along the housing length. No more wasted heat when you go from one work size to another.

This new Chromalox Far-Infrared versatility means real dollars and cents savings along with the built-in advantages of Chromalox Far-Infrared: metal-sheathed, unbreakable element; infinitely variable output; high intensity, color-blind and uniform radiation.

Your Chromalox representative can give you detailed suggestions of the application of new Chromalox adjustable Far-Infrared Heaters. Or, write us for a copy of Bulletin CS-607.



B-728

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FIRST NAME IN ELECTRIC HEAT

Edwin L. Wiegand Company
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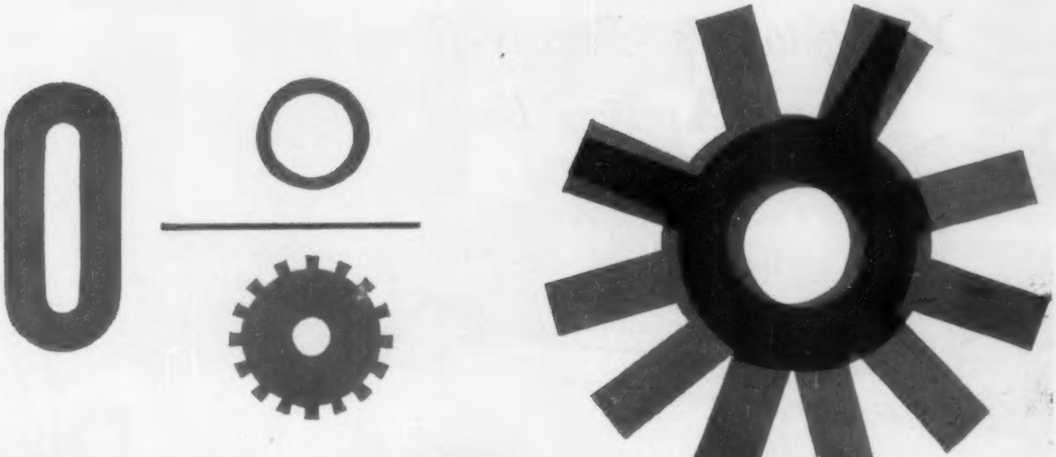
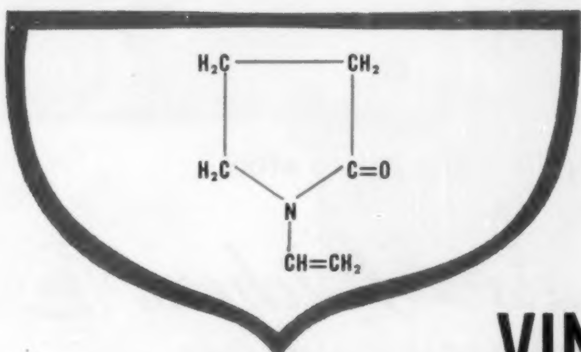
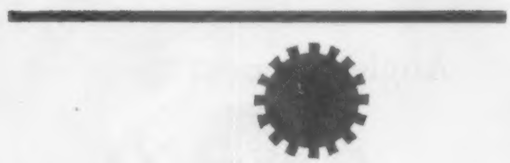






VINYLPYRROLIDONE

for improvement of glass fiber laminating resins and copolymer systems

GLASS FIBER LAMINATES

Vinylpyrrolidone increases both wet and dry flexural strength of glass fiber laminates—the degree of improvement depending on the catalyst and resin systems and the method of fabrication.

COPOLYMER SYSTEMS

Vinylpyrrolidone copolymerizes readily with styrene, maleic anhydride, acrylonitrile, acrylates, vinyl chloride, vinyl acetate and other vinyl monomers. Vinylpyrrolidone also forms addition compounds with phenols which might then be used in preparation of modified phenolic resins.

properties—Copolymer systems with Vinylpyrrolidone improve adhesion properties, dye receptivity, bonding strength, emulsification and complexing action, and solubility control in water and organic solvents.

If you make regular or pressure sensitive adhesives, printing inks, synthetic fibers, emulsion paints or glass fiber laminating resins, or work with copolymerization systems, send for technical information about Vinylpyrrolidone.

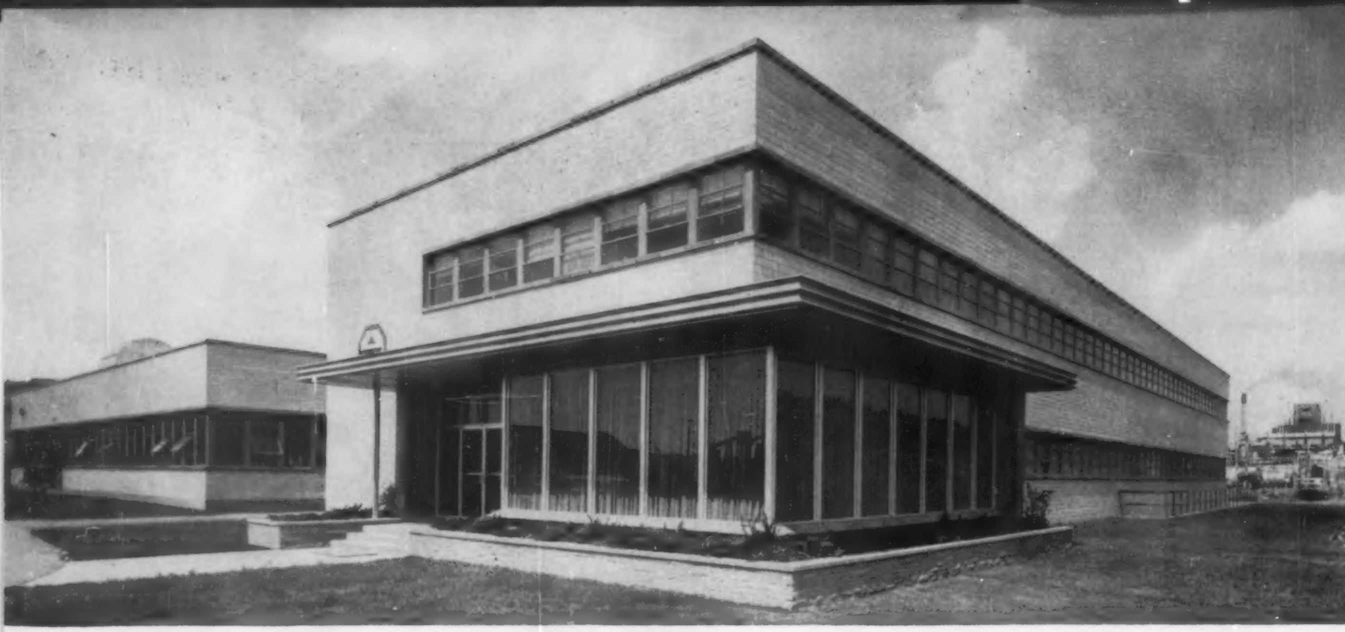
For technical information, price schedules and samples write to:

ANTARA

ACETYLENE CHEMICALS DEPARTMENT
ANTARA. CHEMICALS
A SALES DIVISION OF
GENERAL ANILINE & FILM CORPORATION
435 HUDSON STREET · NEW YORK 14 NEW YORK

gaf

From Research to Reality



New Koppers Development Laboratory promises **better products through finer plastics**

Here are 45,000 square feet of gleaming, modern laboratories, testing rooms, machine shops and fine equipment. They make up the new Koppers Company Development Laboratory at Kobuta, Pennsylvania.

The new lab was inspired by Koppers long-time belief in the dynamic field of plastics. Koppers feels that, in the coming years, even greater strides will be made by the industry, and plans to make every effort possible to assist the industry in this growth.

If one word were to be chosen to sum up the new laboratory, it would almost have to be the word, *"better."* That is why Koppers erected, equipped and staffed this installation . . . why they hired 200 scientists and engineers . . . to devise and perfect *better* plastics and chemicals. But this lab is devoted to more than new plastics and chemicals. A great deal of thinking, testing and effort also goes into making *present* products *better*. In short, this multi-million dollar laboratory has come into being so that Koppers can serve the plastics industry *better* than ever before.

Koppers manufactures DYLITE® expandable polystyrene, the versatile impact-resistant foam plastic for packaging, panel, pipe and cold storage insulation . . . DYLAN® polyethylene for film, sheet, bottle blowing and extrusions . . . . SUPER DYLAN* polyethylene, ideally suited for applications calling for chemical resistance, toughness at high and low temperatures, and ease of processing . . . DYLENE® polystyrene, a rigid thermoplastic for extrusions, injection, compression or vacuum molding. For complete information, write Koppers Company, Inc., Dept. MP-116, Chemical Division, Pittsburgh 19, Pennsylvania.

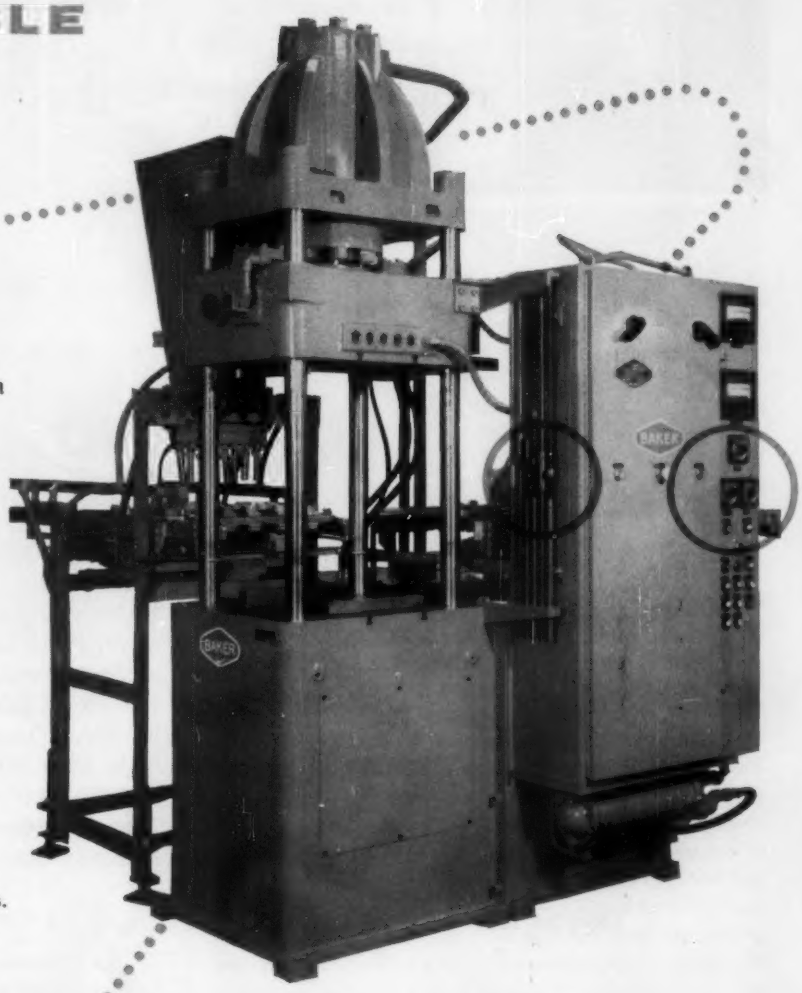
**Koppers Trademark*

KOPPERS

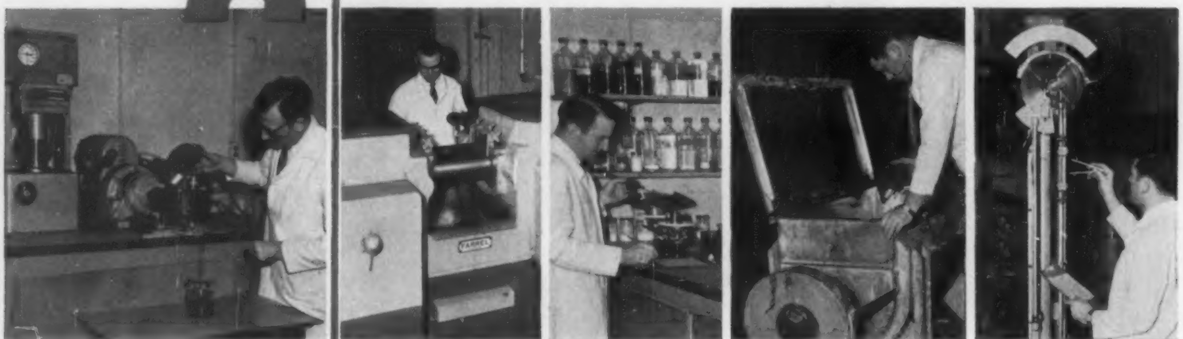
KOPPERS PLASTICS

Sales Offices: PITTSBURGH · NEW YORK · BOSTON · PHILADELPHIA · ATLANTA · CHICAGO · DETROIT · HOUSTON · LOS ANGELES · SAN FRANCISCO

In Canada: Dominion Anilines and Chemicals Ltd., Toronto, Ontario



A. Schulman, Inc. answers today's biggest plastic question . . .



Why are so many molding and extruding plants buying

LABORATORY CONTROLLED

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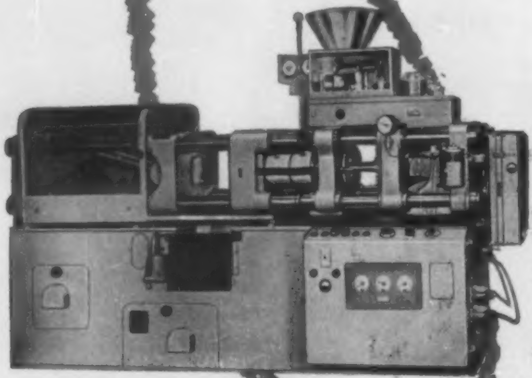

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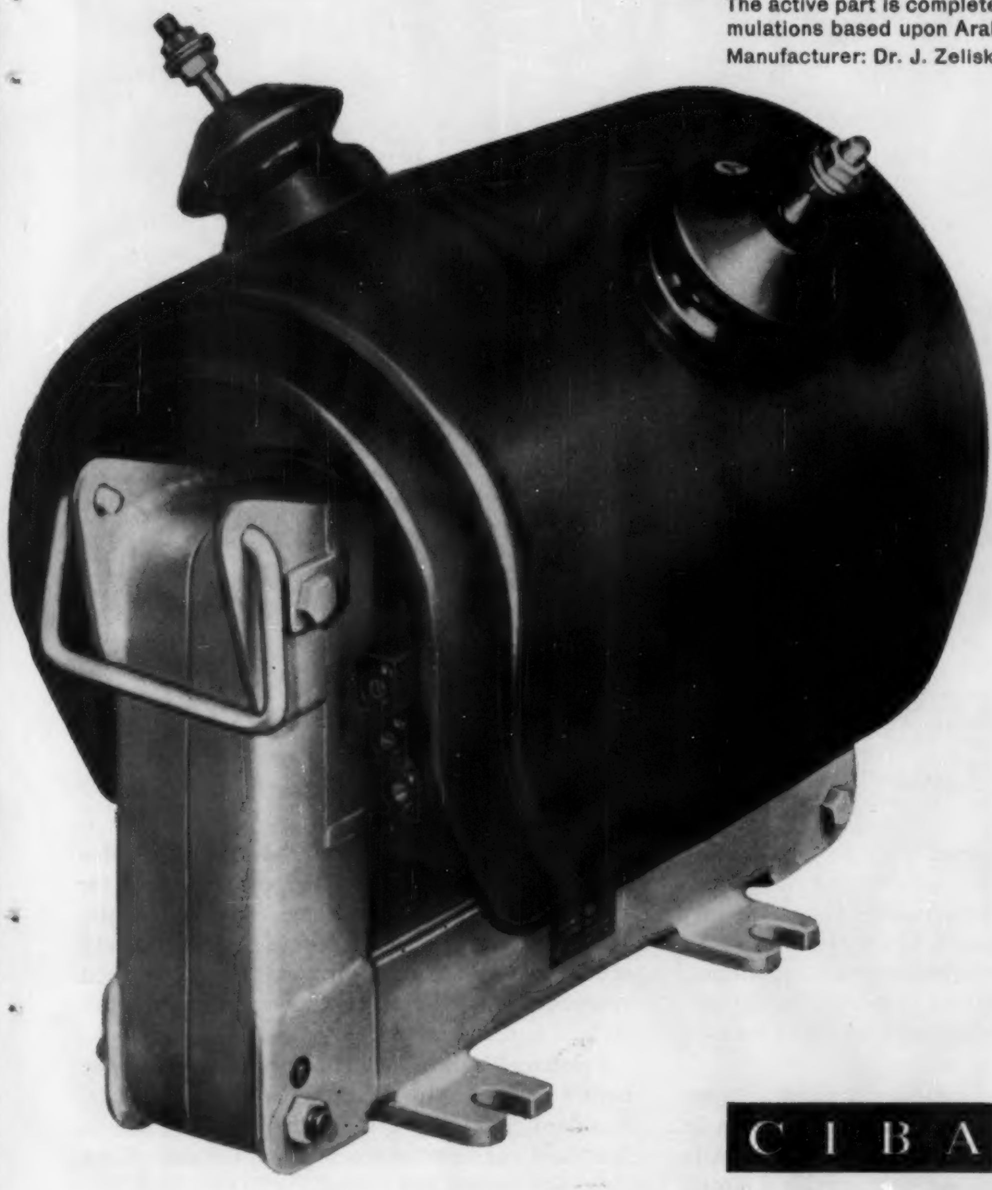

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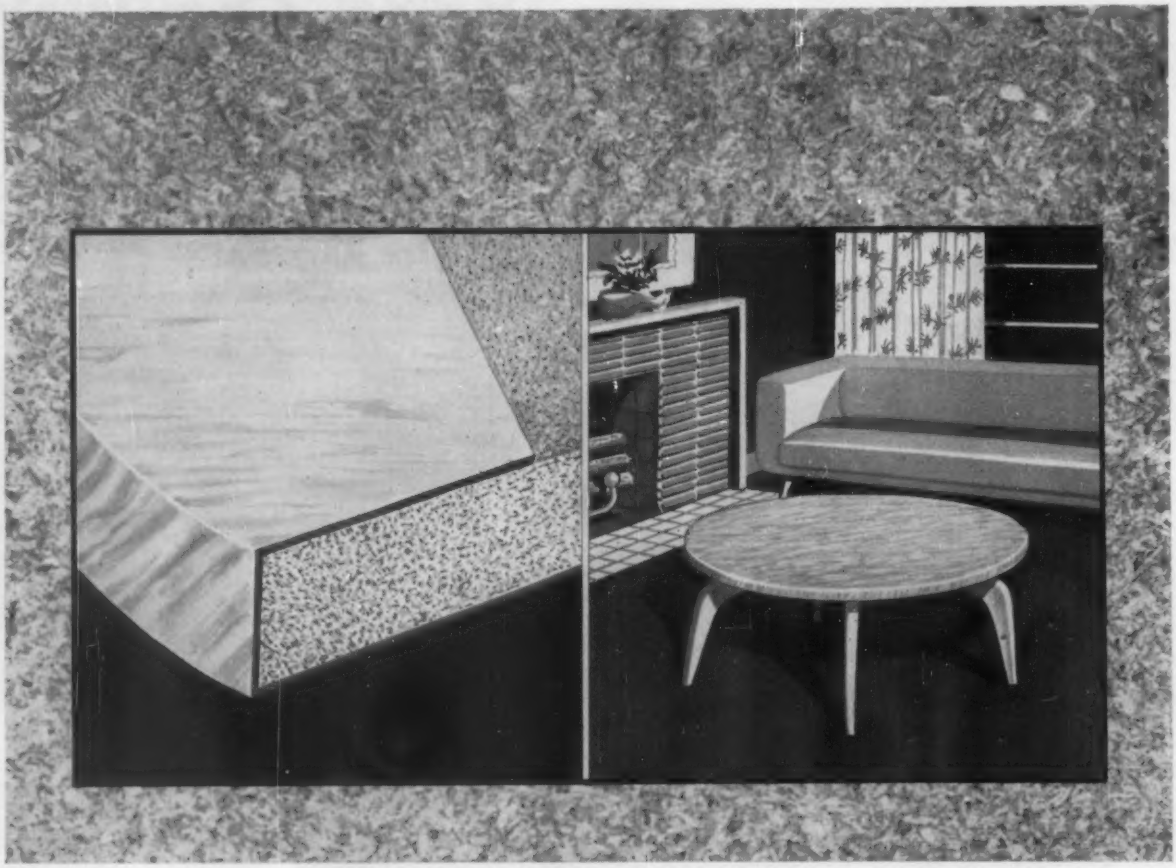

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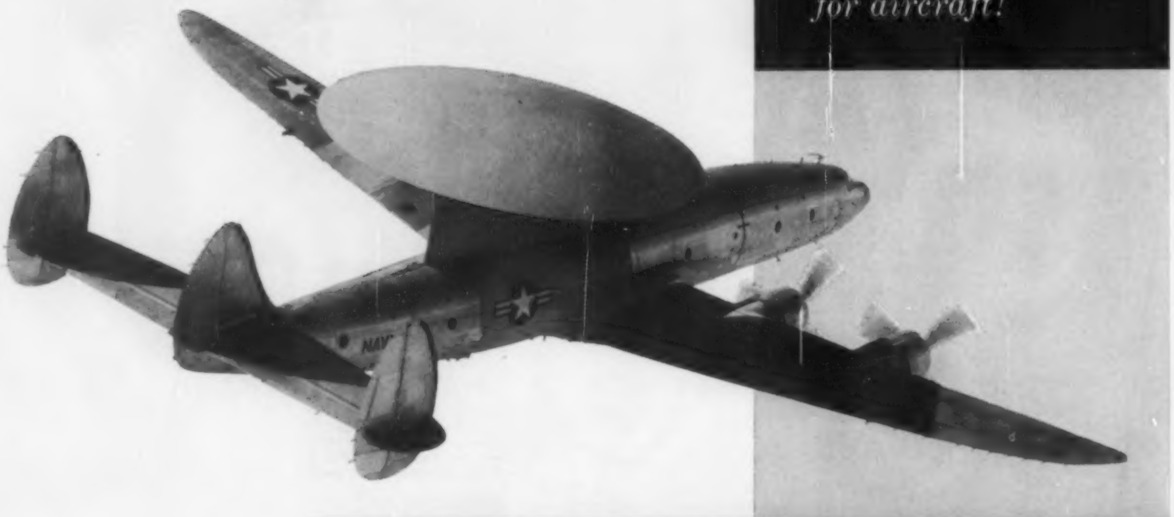
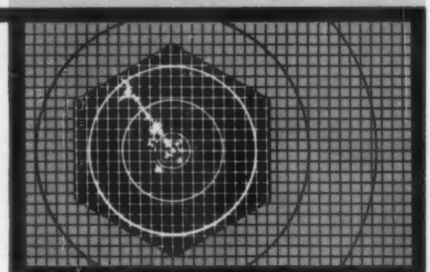
This 30 foot "glass eye" *is the largest honeycomb lay-up ever made for aircraft!*





This single, flying saucer-shaped molding of Hexcel glass-fabric honeycomb houses the largest and keenest-eyed radar ever flown. An advanced version of the Navy WV-2 Super Constellation, its 30-foot discoid radome gives even sharper vision to America's far-flung early warning network.

Lockheed engineers, in designing this piggyback radar station, chose Hexcel Honeycomb not only for its light weight and great rigidity, but also for its microwave transmission properties.

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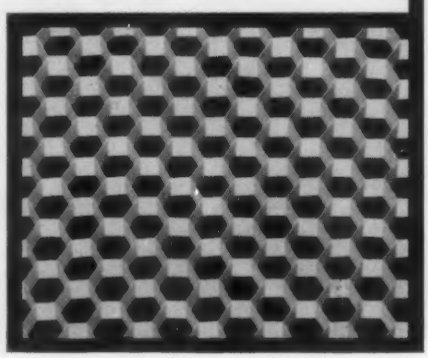

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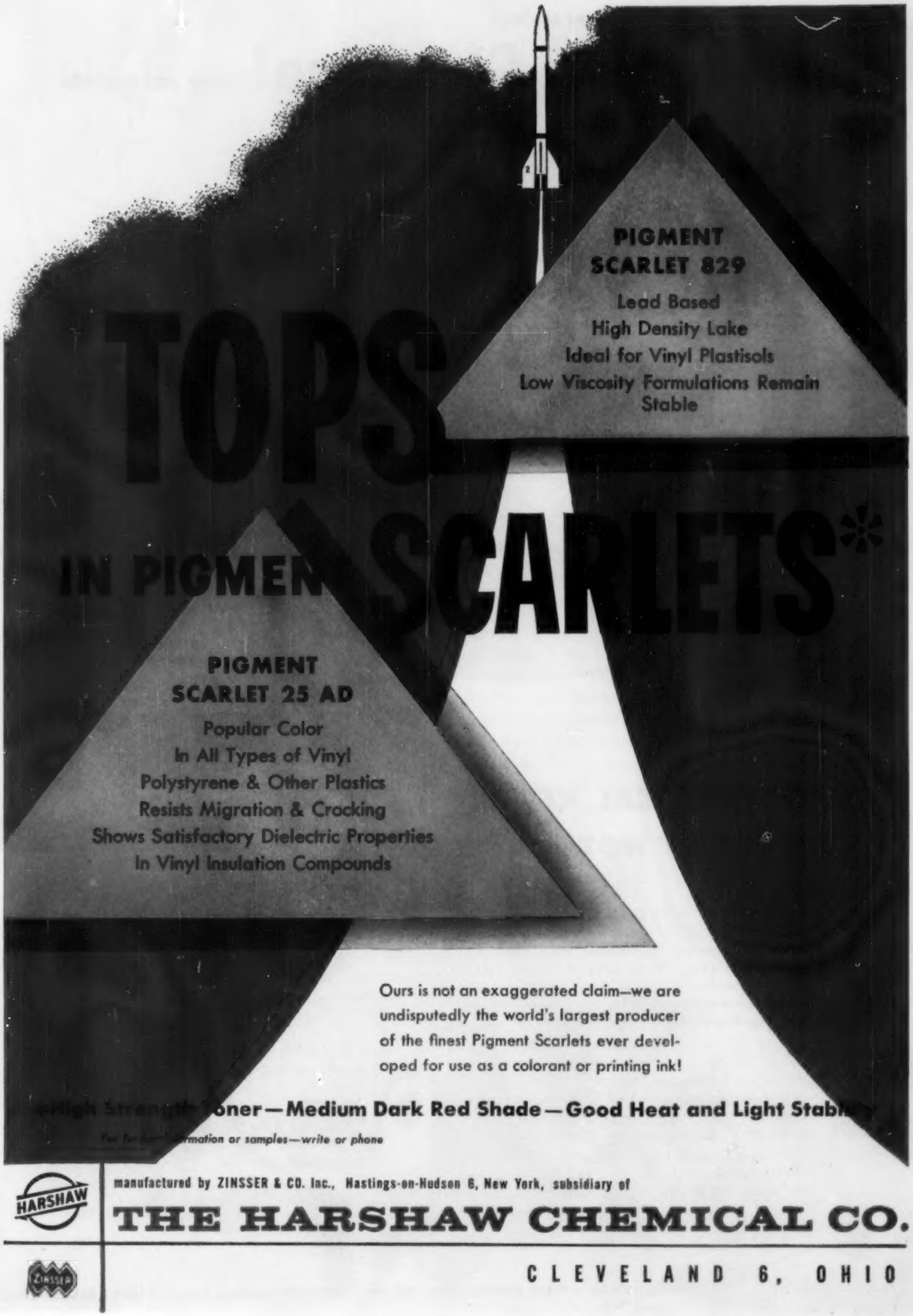
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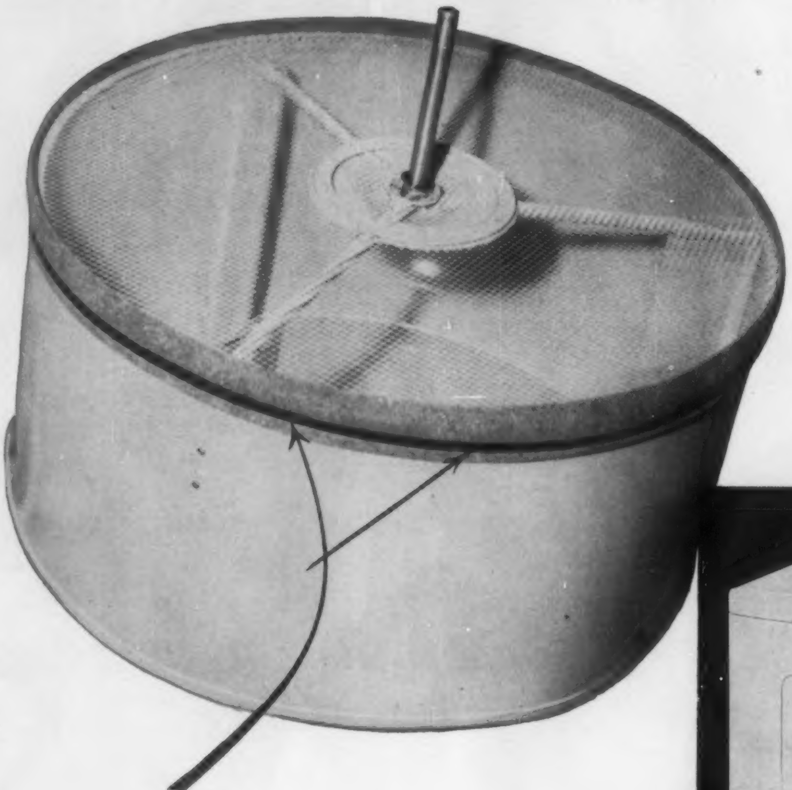

American Felt Company, Glenville, Conn., produces the seals for this RCA WHIRLPOOL dryer. Plain felt is used at the loading end; felt blended with Hycar latex is used at the damp exhaust end.

IMPROVED SEAL KEEPS A LOT OF HOT AIR AT WORK

AIR at the exhaust end of this RCA WHIRLPOOL dryer is not only hot but laden with moisture. Yet the seals must stay strong and resilient to keep this hot, moist air in the exhaust duct where it belongs, and maintain an effective barrier between the rotating drum and its cabinet.

Thus the seal manufacturer blended Hycar nitrile rubber latex into his felt material to provide a moisture-resistant seal that stands up under this service. And Whirlpool-Seeger reports: "the Hycar-treated felt is much more satisfactory than anything previously used".

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MODERN PLASTICS
Volume 34
November
1956
Number 3

New combinations of materials, new molding methods, new designs make plastics the big news in trucks and trailers

From jeeps to giants

At every conclave of truck and truck body manufacturers and at every meeting of truck operators the word "plastics" is increasingly used.

Behind all this reference to plastics is its growing use in truck body construction, and behind that again are hard economic facts. Properly selected plastics, when used as a replacement for steel, wood, aluminum, and other materials traditionally used in truck body construction, can reduce operating and maintenance costs, boost payloads through elimination of excess weight, and provide superior insulation for products requiring refrigeration.

How big, volumewise, is the truck field? According to U. S. Dept. of Commerce figures, the value of factory shipments of truck trailers alone in 1955 was $371 million, an increase of 51% over 1954. The relative production figures are 76,468 trailer units in 1955 compared with 54,537 in 1954. These totals included furniture vans, insulated and refrigerated vans, and other types of closed top vans, as well as open vans and tank and platform trailers.

As to trucks, U. S. manufacturers during

Fig. 1: Reinforced plastic milk tank trailer (left) offers improved insulation and lighter weight. Another milk tank trailer (below) has equipment cabinet molded into back of the unit. (Photos, Heil)

Fig. 2: Jeep (above) has reinforced plastics hardtop. Interior view (right) shows ribs molded into top. (Photos, Willys)

Fig. 3: Laminate enclosure for another type of Jeep is supplied knocked down, can be installed by dealers. (Photo, Willys)

1955 turned out more than 1¼ million trucks; and in 1956 the total should exceed a million units. According to *The New York Times,* there are now nearly ten million trucks, tractors, and trailers registered in this country, of which more than half belong to one-vehicle operators. More than 84% of all trucks, it was stated, are in fleets of fewer than nine vehicles, emphasizing the large number of individual owners as well as the specialized requirements of the field. Many of the properties of plastics are adapted to meeting these requirements.

Reinforced plastics—particularly fibrous glass reinforced polyester laminates—are the dominant types of plastics being used in this industry. Also of growing importance are some of the plastic foams, which are used primarily for their insulation properties and as a core material in double wall construction, and such products as vinyl-coated nylon cloth. The latter offers a number of advantages over conventional canvas tarpaulins used as covers for open-top trailers and may eventually capture an important share of this market.

The adaptability of plastics in truck and trailer body construction can best be illustrated through reference to specific body types, varying from small, light-weight delivery vehicles to massive over-the-road trailers.

Small converting units

The versatile Jeep has stimulated the development of several types of specially designed tops and enclosures incorporating plastic materials. For one of these units Molded Fiber Glass Body Co., Ashtabula, Ohio, is producing

Fig. 4: With lightweight one-piece reinforced plastics cover, two men can convert open-bed pick-up truck to panel type in less than 5 minutes. (Photo, Barrett Div.)

Fig. 5: Similar in design and purpose to unit shown in Fig. 4 is 300-lb. one-piece enclosure, 8 ft. long and more than 6 ft. wide. (Photo, Glas Laminates)

Fig. 6: Three-wheel mail delivery truck has body and canopy of polyester-glass laminate construction. (Photo, Celanese)

a reinforced plastics roof. This is used in a new enclosure for the Willys Dispatcher, a "civilianized" two-wheel drive version of the Jeep, shown in Fig. 2, opposite. In addition to offering a weather-proof covering, the top is translucent white, allowing a soft light to illuminate the cab interior—an important advantage because the vehicle is intended primarily for package delivery. The plastic top, which weighs 32 lb., incorporates a molded drip rail with four holes for drainage. Insulating properties of the laminated plastic material eliminate the need for the customary sound and heat insulation used with a steel roof.

The top, measuring 70 by 60 in. and having a minimum thickness of 0.10 in., is produced in matched metal dies, using polyester resin with a build-up of 5½-oz. glass mat giving added strength. Three percent white pigment is mixed with the resin. Cross ribs, spaced 5 in. apart,

Fig. 7: Top, sides, and front of truck body are molded in one piece. Interior (right) is easy to clean. (Photo, Dominion Rubber)

Fig. 8: Translucent reinforced plastic roof provides good lighting in truck interior, above. (Photos, Montpelier)

give the roof the required rigidity. Tops are delivered to Willys as they emerge from the presses, and the necessary holes are drilled for joining them to the sheet metal enclosure. The top is assembled to the sides with screws and lock nuts; a mastic sealer applied between the top and sides makes the cab completely weatherproof.

Also of reinforced plastic construction is the complete RP-1 enclosure made for the Willys Jeep by Reinforced Plastics Corp., Vineyard Haven, Mass. (See Fig. 3.) This unit, having a total weight of 166 lb., transforms the Jeep into a high-utility, all-weather vehicle with outstanding comfort and convenience features. Delivered to the user knocked down, it may be installed in a matter of minutes by dealers, being attached to the body of the Jeep by means of six conventional fittings. The rear door of the enclosure, which slides upward and under the roof, affords additional ventilation and permits carrying loads which extend beyond the rear of the vehicle.

The side panels, side doors, top, and rear doors of this enclosure are bag-molded on epoxy-fibrous glass-layup dies. Placed in a thermostatically controlled circulating hot air oven, the sections are cured for one hour at 140° F., then removed from the dies and trimmed to size. In making the layups, plywood stiffeners are incorporated in some of the sections, producing greater rigidity.

Half-ton and ¾-ton open-bed pickup trucks

Fig. 9: Rugged one-piece reinforced plastic truck domes are 3 ft. high, 11 ft. long, weigh only 150 pounds. (Photo, U. S. Rubber)

Fig. 10: Molded laminate side racks for flat-bed trailers can be removed in less than 15 minutes. (Photo, K. R. MacDonald)

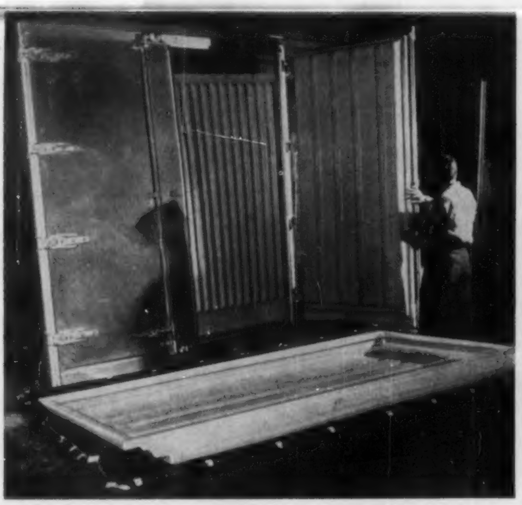


Fig. 11: Plastic door liners and corrugated wall liners reduce dead weight and increase truck's pay load. (Photo, Rohm & Haas)

Fig. 12: Trailer nose sections, also fabricated of reinforced plastics, are made by hand lay-up process. (Photo, Rohm & Haas)

may be easily converted to panel models with a new one-piece reinforced plastic cover introduced by Eastern Glas Laminates, Inc., Meyersdale, Pa. The cover can be used to convert open-bed trucks to panel design in less than five minutes, as shown in Fig. 4. The molded truck covers are produced in several models and will fit Chevrolet, Ford, Dodge, GMC, International, and Willys ½ or ¾-ton units. One model has windows and a rear lift door; another, specially adapted for sportsmen and campers, features a cross-the-bed shelf for bed rolls or air mattresses. A built-in sliding floor provides quick access to equipment being carried and can be pulled out to make a camp table or work bench.

Basically similar in design and construction is the Glas-Top one-piece cover for open bed trucks produced by Glas Laminates, Inc., Costa Mesa, Calif. Particularly noteworthy among the truck enclosures made by this firm is the "Roamer Jr.," a 300-lb. cover measuring 8 ft. long, more than 6 ft. wide and 4 ft. 4 in. from bed of truck to top of cover. Among the features of this top are a full length rear door, with lock, and windows sealed in rubber. In constructing the Glas-Top truck covers, Glas Laminates, Inc., uses a hand-layup process on reinforced plastic molds built from original mock-ups of plaster of Paris, plywood, and chicken wire. It is shown in Fig. 5.

Package delivery trucks

Although truck manufacturers supply some units complete with standard types of bodies, it is a very common practice in this industry to purchase a basic truck chassis and have it equipped with a body particularly adapted to the user's requirements. Thus, there are many

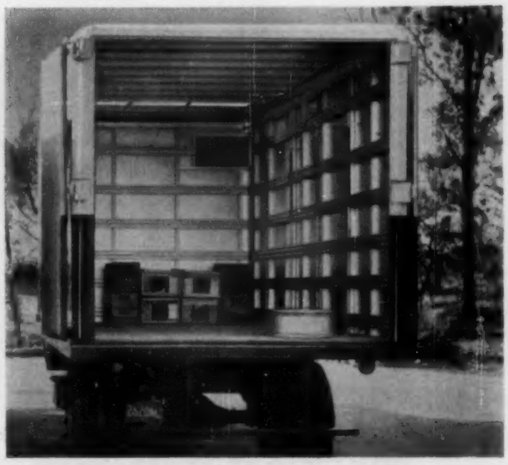


Fig. 13: Translucent laminate skylight makes visual identification of packages easy. (Photo, International Molded Plastics)

Fig. 14: Abrasion-resistant vinyl-coated nylon tarpaulin is translucent enough to permit daylight loading. (Photo, Goodrich)

Fig. 15: Bright truck interior encourages cleanliness and facilitates sanitary maintenance. (Photo, Celanese)

Fig. 16: Slabs of styrene foam used as truck floor insulation possess high resistance to moisture vapor transmission. (Photo, Dow)

companies located in various parts of the country which specialize in the production of plastics truck bodies only. A United Parcel delivery truck molded of reinforced plastics by Lunn Laminates, Inc., Huntington Station, N. Y., gave a weight saving of 1000 lb. over an aluminum body. Extensive testing of the parcel truck also showed that it held the road better, due to its lower center of gravity, while the one-piece construction eliminated vibration.

Typical of companies specializing in custom-built plastics bodies are The Montpelier Mfg. Co., Montpelier, Ohio; General Body Mfg. Co., Kansas City, Mo.; Wilson Motor Bodies Ltd., Long Branch, Ontario; and Metropolitan Body Co., Div. International Harvester Co., Bridgeport, Conn.

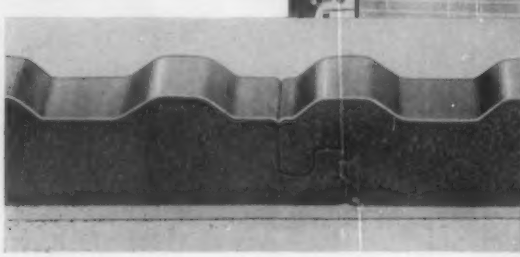
Light weight panel delivery truck bodies operated by a large Midwest baking concern are among the plastic units which have been built by General Body Mfg. Co. General also builds a specially designed delivery scooter body for Cushman Motor Works, Lincoln, Neb. Called the "Mailster," this unit is shown in Fig. 6.

This three-wheel vehicle, built for the U.S. Post Office for mail delivery in rural areas, makes use of reinforced polyester construction in the body and canopy. The cargo box of this lightweight delivery unit has a ¼ ton capacity.

Wilson Motor Body's new Packette parcel delivery truck is described as the first plastic truck built in Canada. It is shown in Fig. 7, p. 105. By molding the Packett body it was

Fig. 17: (below)—Sandwich panel for truck body has reinforced plastic skin and foamed styrene core.

Fig. 18: (right)—For trucks needing controlled temperatures, panels offer excellent insulation. (Photos, Haskelite)



possible to incorporate certain design features in compound curves which would have been practically impossible in metal. Since the top, sides, and front of the body are each molded in one piece, the finished unit is practically leak-proof. Stronger than an aluminum body of greater weight, the all-plastic Packette body scales less than 1000 pounds. Custom molding facilities of Fleet Mfg. Ltd., Fort Erie, Ontario, were used in developing this body.

One major truck body supplier whose activities involve the construction of *both* metal and reinforced plastics bodies is the Montpelier Mfg. Co. A typical Montpelier body is shown in Fig. 8.

Montpelier points out that the reduced weight of its reinforced plastics truck bodies saves tires and gas and increases load capacity. Bodies offer improved sanitation since they do not absorb odors and the interiors can be easily cleaned with steam or water. Corrosion and rust resistant, the bodies are virtually immune to damage, but can be easily patched without special skill. Their superior insulating characteristics are indicated by the fact that the Montpelier laminated plastic body panels have a thermal conductivity of only 1.2 BTU/hr., sq. ft. (°F./in.) as compared to 1200 to 1500 BTU for aluminum and 275 to 325 for steel panels.

On the negative side, H. A. Schwartz of Montpelier cites "the unfamiliarity of working personnel with the exacting and careful procedure required to make sure that the materials are used in proper proportion and with proper timing. We believe further disadvantage at the present time is the necessity of handling various ingredients in successive operations. Perhaps new procedures may eventually be worked out where the materials could be handled concurrently."

Specialized truck parts

In the truck body field, the use of plastics is by no means limited to small package delivery units. For example, dome-shaped lids for huge truck trailers used to haul dry cement are being made by Commercial Plastics Co., Santa Ana, Calif. The 3-ft. high domes, shown in Fig. 9, 11 ft. long and 8 ft. wide, are molded in one piece. Despite their size, the units weigh only 150 pounds. These rust-proof, shatterproof covers are replacing riveted aluminum lids because they will not leak air or cement; in addition, moisture, which could cake the cement, won't form on the reinforced plastic. The plastic parts are easier and more economical to make than comparable metal parts for the 14-ton capacity trailers. About 50 trailers equipped with the new domes are now in service. Some of them have already rolled up more than 50,000 miles of use without any repairs being required on the domes.

Reinforced plastics side racks, in color, for flat bed trailers are a new product made by Plasti-Glas, Inc., Portland, Ore., a wholly-owned subsidiary of Consolidated Freightways, Inc., one of the nation's largest motor truck transport operators. The new lightweight racks, made in 78- or 90-in. heights, are being manufactured for use on 24-, 35-, and 40-ft. standard make flat bed truck trailers. They have been tested by Consolidated in more than 4½ million miles of actual over-the-road operation.

Made with durable metal stakes laminated into the panels, the racks help reduce labor costs since one man can remove and stack them on a 24-ft. trailer in less than 15 minutes. A complete set of racks for a 24-ft. trailer weighs only 1100 pounds. The set includes front and side panels, rear doors, aluminum bows, hardware, and attaching parts. If lost or destroyed, panels may be replaced individually since they are interchangeable from trailers of like size. Recessed aluminum handles facilitate lifting and carrying the individual panels. Fig. 10 shows how.

Trailer nose sections, door liners, and corrugated wall liners are among the numerous reinforced plastic parts for trucks produced by Universal Moulded Products (*To page* 220)

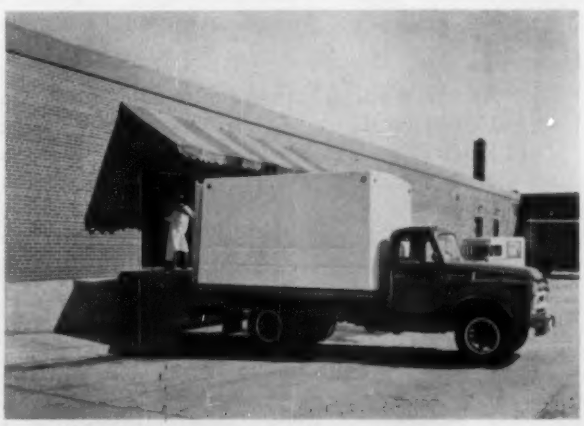
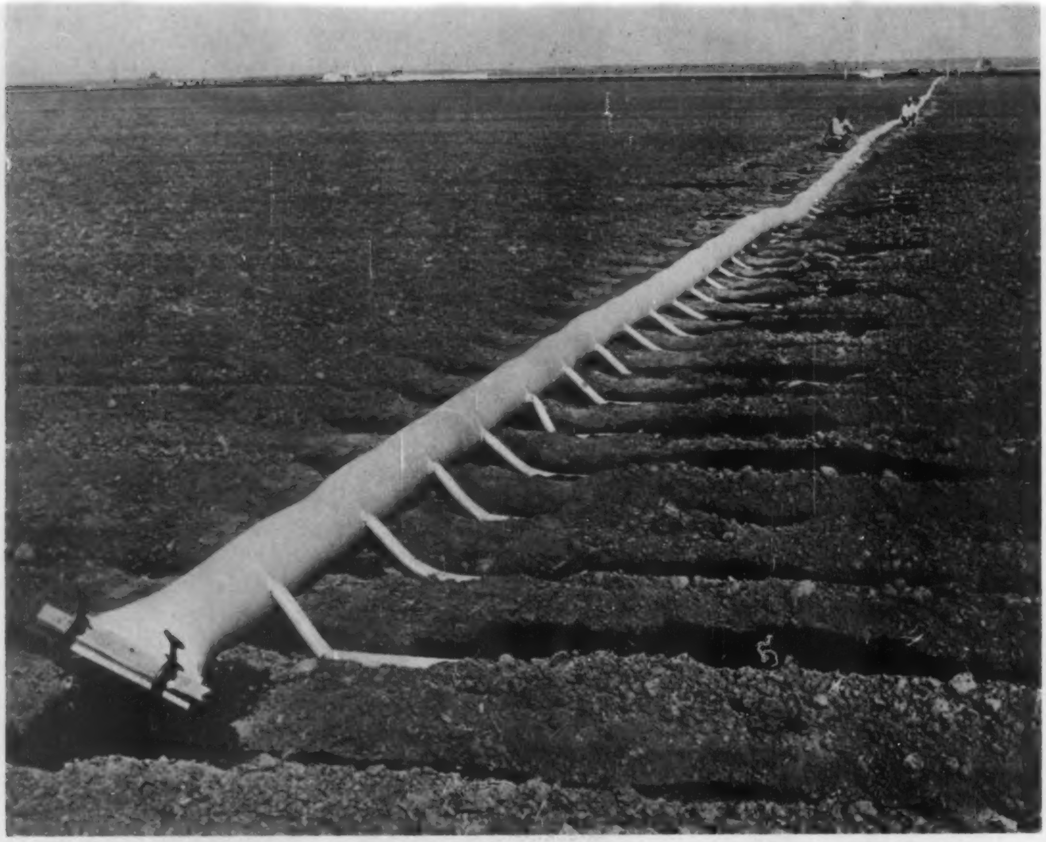


Fig. 19: Refrigerated truck body is molded in one piece of reinforced plastics. Insulating core is balsa wood. (Photo, Heil)



Field being irrigated with aid of portable elastomeric vinyl ditch. There is no loss of water through seepage or evaporation as it moves through tube from source to crops. (Photos, Trinity Products, Inc.)

Portable ditch

Excellent weathering properties of extruded vinyl tubing make it ideal for easily handled irrigation set-ups

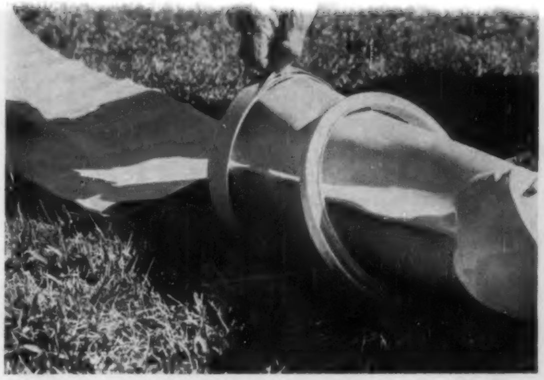
In the Western United States alone there are 15,000,000 acres of surface-irrigated lands. Much of this irrigation is accomplished by open ditches and rigid aluminum or plastic siphon tubes.

Long needed was a flexible plastic irrigation tube in lengths which could be easily assembled in the field and which could be rolled up for storage.

Over 1 million ft. in use

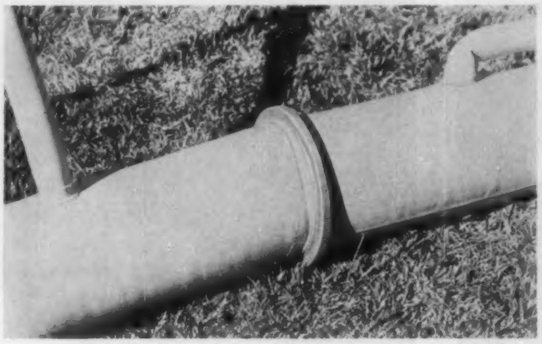
Three years ago Trinity Products Inc., Trinity, Texas, produced its first flexible vinyl surface-irrigation tubing called Flex-Flume. Today over 1 million ft. of it are in use and sales are continuing to expand at an increasingly rapid rate.

Aside from its portability, this vinyl ditch saves time and expense in grading fields since they need to be graded in one direction only. It moves all the water from source to crop, eliminating water loss through seepage and evaporation. It prevents ditch loss of liquid fertilizer. It saves labor and expense because no angular fittings are needed such as are required for rigid irrigation pipes. It reduces the spread of noxious weed seeds which, when they fall into open water, are carried to crop rows. Less pressure is needed to force a given amount of water through this tube. Finally, by simple flow



Lengths of tubing are easily joined; end of one tube is heated on inside and tube pulled backward over ring previously placed around it

End of other tube is also heated and then pulled over ringed piece. Joint is completed by means of a yoke

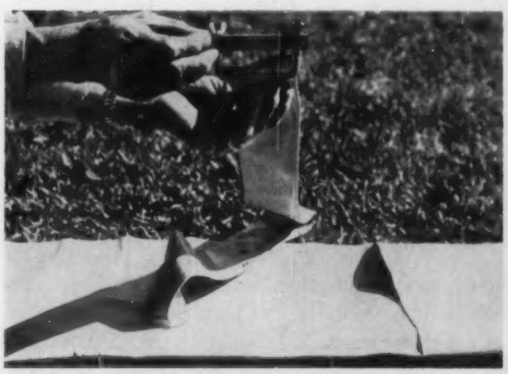


Completed seal is strong and watertight, does not affect the efficiency of the irrigation system

control devices, the amount of water delivered to each crop row is readily controlled.

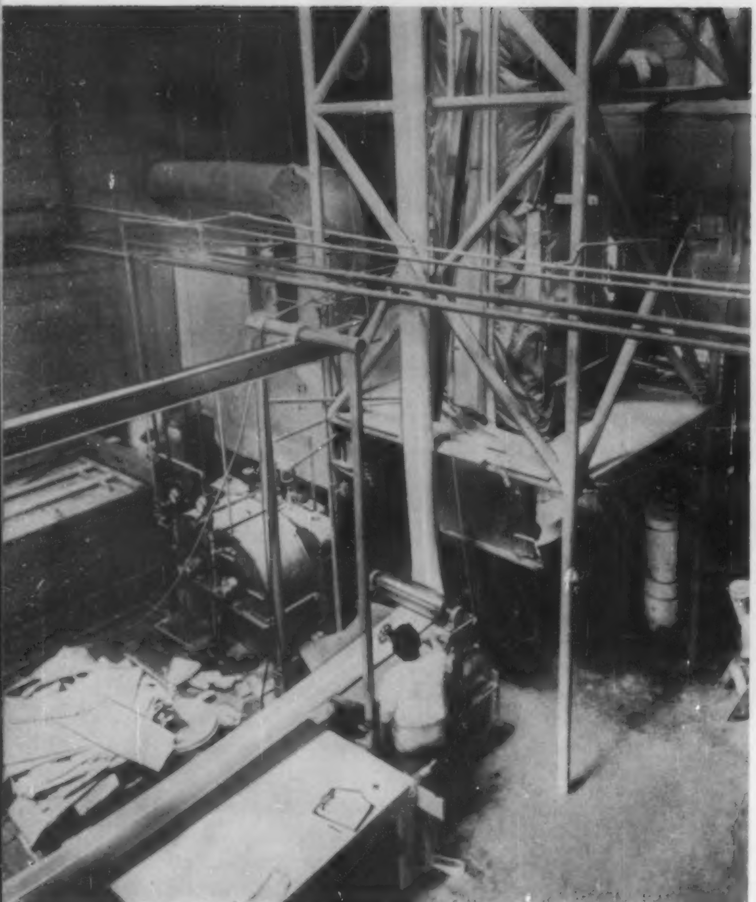
The production of the Flex-Flume pipe is a fairly standard manufacturing process involving mill compounding, extrusion, cutting, and electronic welding of row outlets to the main tube.

The secret of the success of this tubing is, however, in the compounding of the material. It may be a relatively simple matter to produce rigid tubing which will stand up to heat and cold and chemical attack from soil and water, but elastomeric tubing is an entirely different matter. The resin-stabilizer-plasticizer-filler-pigment formulation of the Flex-Flume tubing presently being marketed is the result of over

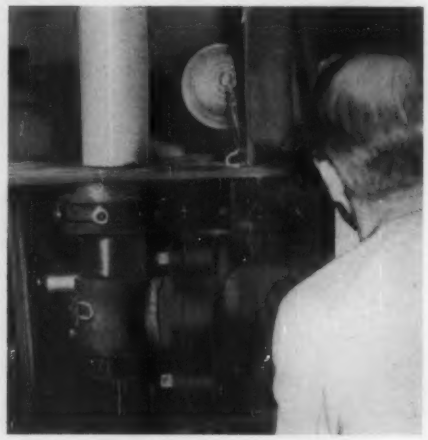


Clamp for water flow control is installed by simply slipping outlet tube through opening. Size of opening determines flow

Water flow from tube outlet is easily and effectively controlled by means of an adjustable thumbscrew clamp



Operator supervises take-off of tubing traveling down toward him and out of picture at lower left corner, after rising through draft shield on his right. Extruder and die are concealed in shadows under shield



Tubing emerges from die and is internally supported by slight positive air pressure as it rises into draft shield. (Photos, Trinity)

6000 test combinations of the raw materials. And it is so satisfactory that the company offers a three-year warranty on its product.

How tube is installed

From the standpoint of the farmer, the use and installation of the tubing is a "do-it-yourself" proposition. Lengths are assembled by means of quick-fit couplings consisting of two rings and a pressure yoke. Using a small torch, the end of the tubing is heated on the inside and quickly becomes soft and pliable enough to be stretched backwards over a ring placed around the tubing. The end of the other length of tubing to be joined is then heated and pulled over the ringed piece and a yoke is then pulled over the belled-out portion of tubing to make a watertight seal. After this initial installation has been made and the belled-out portion of tubing has been clamped with the yoke, it will retain this shape; it is not necessary to heat this tubing each time the system is connected. The device for controlling ditch flow from the outlet tubing is a simple thumbscrew clamp.

Since there is a direct relationship between pressure available and size of tubing, the company has produced a head loss chart showing purchasers how to calculate the proper size of tubing. Since there are different row spacings from 22 in. to 120 in., the number of outlets per 100 ft. of tubing varies from 54 to 10.

While in field demonstrations the company representatives think nothing of running a truck over a length of water-filled tubing, this is not recommended to farmers as a practice; it is easy to uncouple lengths to make gateways into fields for cultivating equipment. And if a length of plastic pipe should get damaged or torn it can be easily fixed in the field with a special repair kit.

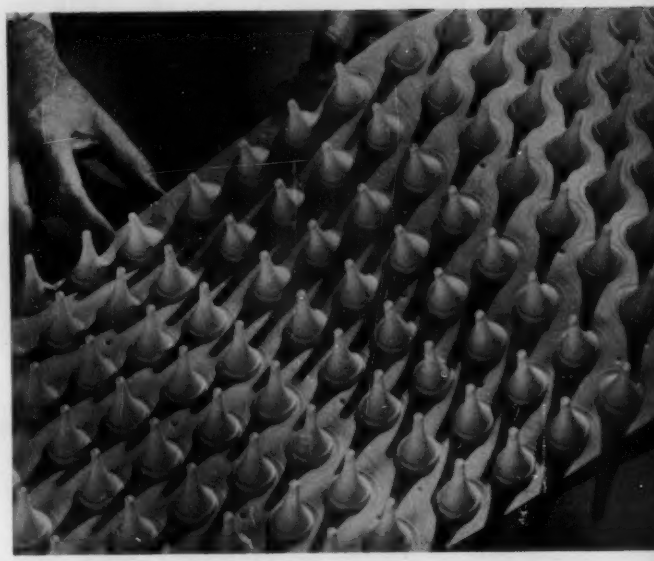
Disposable specula

Low-cost sanitary covering for medical instrument is pressure formed in one piece of 10-gage vinyl sheet

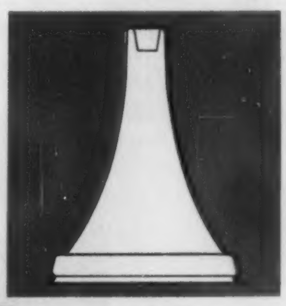
Deep draw from a small diameter, tricky undercuts and turned-back lips, and extremely close tolerances were among the troublesome problems successfully overcome by Plaxall, Inc., Long Island City, N. Y., in engineering for the medical field a formed vinyl speculum low enough in cost to be economical as a single-use disposable.

A speculum is the funnel-shaped front end of an otoscope (a medical instrument for examining the ear) which is used for dilating ear passages to give the doctor a better view. Conventionally, otoscopes are equipped with a permanent inner metal speculum and a removable outer metal speculum. It is this latter piece that the plastic speculum, designed by Welch Allyn, Inc., Skaneateles Falls, N. Y., will replace.

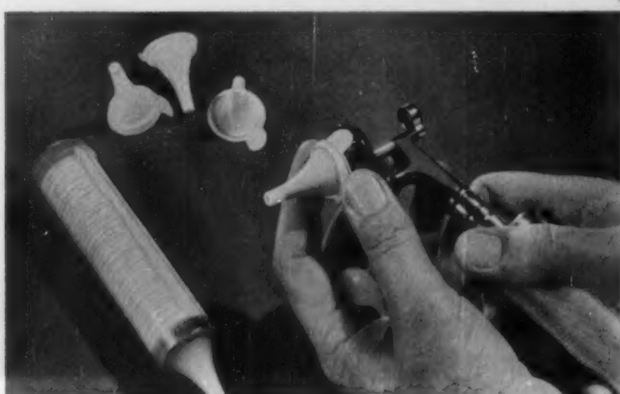
According to Welch Allyn, who is the country's leading manufacturer of otoscopes, the disposable specula provide new standards in efficiency and cleanliness. Unlike old-style metal specula which have to be sterilized after each use to prevent cross-infection, the vinyl speculum is simply pulled off the permanent inner part and discarded. Weighing only ½ as much as the old-style metal piece and designed to nest together compactly, a full supply of fresh, clean specula can easily be carried in a minimum of space by doctors on house calls—and there are no soiled (To page 227)



Low-cost disposable specula for use on otoscope are pressure formed continuously, 32 at a time, on roll of 10-gage vinyl sheet



Cross-section sketch of speculum shows undercut shoulder (at bottom) and turned-in lip (at top) formed into the piece



Doctor slips speculum over tip of otoscope. After use, the piece is removed and discarded. Specula are packaged in acetate tube (left). (Photos, Plaxall)

Refrigerator-freezer unit, fabricated almost entirely of lightweight, structurally strong plastics sandwich materials, is built into wall at a convenient height for easy access to the 13-cu. ft. capacity interior. (All photos, Westinghouse)

First all-plastics refrigerator

features sandwich construction—reinforced plastics, styrene alloy sheet skins, foamed styrene insulation

The first achievement to come along in recent years which gives promise of accelerating the rate of refrigerator obsolescence to such a degree as to make necessary a complete revamping of the industry's current merchandising techniques is, appropriately enough, an achievement in plastics—the first virtually all-plastics refrigerator eminently adaptable to the production line.

As introduced by Westinghouse Electric Corp., Electric Appliance Div., the revolutionary appliance is based on a simple plastic "sandwich" construction. The exterior skin of the sandwich is a sheet of polyester resin-fibrous glass laminate; the inside skin is a sheet of high-impact styrene alloy; and the core is a 2½- to 3-in.-thick layer of styrene foam insulation.

By taking advantage of the physical characteristics of this sandwich construction, Westinghouse engineers have come up with a basic refrigerator body that is strong, weighs ⅓ as much as a similar body in steel, has excellent insulation characteristics, offers unprecedented

Fig. 1: Sandwich for refrigerator construction is laid up prior to lamination in hydraulic press. Exterior skin is reinforced plastics; interior skin is styrene alloy; core is styrene foam

flexibility in styling, and, most important of all, can be fabricated quickly in almost any style or shape with the barest minimum investment in tooling. Since each refrigerator cabinet is formed from a single flat sheet of the sandwich material, fabrication consists basically of simply mitering out the corners, folding the sandwich panel together like a cardboard carton, and bonding the corners together with an epoxy resin adhesive.

Sample built-in versions of the revolutionary refrigerator are already on test in a number of homes and pilot plant production of additional sample models is now under way at the Westinghouse manufacturing plant in Columbus, Ohio.

Market implications

The repercussions which the introduction of the all-plastics refrigerator is expected to have on the future thinking of the industry will probably be felt for some time to come. For years, the refrigeration industry, with its eyes on the vast replacement market that exists for staple appliances, has been trying to develop a way to accelerate obsolescence by a continuous program of annually improving product design and styling—in much the same way as the automobile industry taps the replacement market by bringing out new and improved models every year. Unfortunately, however, the refrigerator industry has not been able so far to produce each year models that are so different from those introduced the previous season to obsolete earlier models and send the housewife clamoring for the latest version.

Heretofore, of course, the major drawback to successfully carrying out this theory of "dynamic obsolescence" has been the tooling costs involved. When working with conventional refrigerators, it is economically impossible to market-test different types of designs or even to change design with any degree of frequency. Literally tens or even hundreds of thousands of conventional models must be produced by a given set of tools before they can be amortized

Fig. 2: Front and back edges of plank which eventually will form cabinet body are cut with double tenon. These edges insert into the back panel in later assembly

Fig. 3: "V-joints" for corners of cabinet are then cut through inner skin and core of the sandwich just down to outer skin

Fig. 4: Plank is next folded at V-joints (like cardboard carton) around interior partitions previously sub-assembled. Partitions are also of sandwich materials

Fig. 5: Using a wooden templet, openings to accommodate refrigerator compressor and evaporator mechanisms are routed out of the sandwich sheet which serves as the back panel of the unit

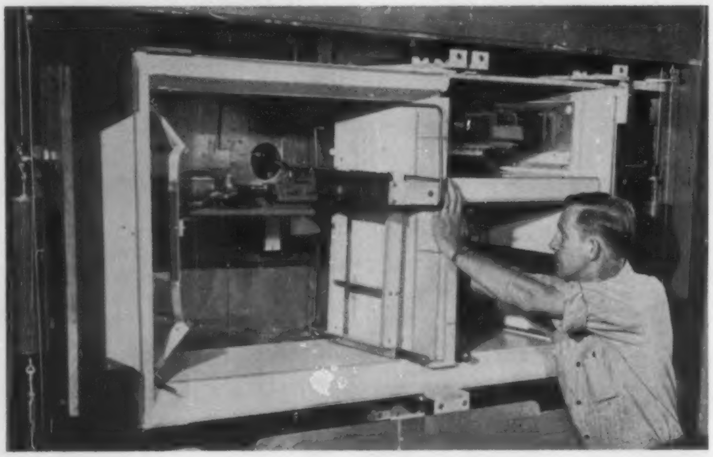


Fig. 6: Meanwhile, the mitered joints which form the corners of the folded cabinet body are treated with an epoxy resin adhesive and the entire assembly is set up in a positioning jig. Radio-frequency energy (about 39,000 v.) applied to the corners at this time cures the epoxy adhesive. Interior partitions are also epoxy-bonded to sides

while keeping the product priced competitively.

With the introduction of the plastics version, the picture is changed completely. Actually, the sandwich material itself is more expensive than the steel and fibrous glass insulation traditionally used. Consequently, roughly 50% of the cost of the new refrigerators is in the materials, as compared to 35 to 40% materials cost in conventional models. The ease of fabrication, however, (see description, below) cuts down tooling costs on the plastics models so drastically (by as much as 80%) that they can be priced competitively with traditionally-made models. About all that is needed to cut the sandwich panels (which serve both as exterior and interior of the refrigerator) to any size and shape is an electric saw.

Moreover, it is claimed that a complete new plastic model, exclusive of steel or chrome trim, can be developed and put into production in less than two weeks. Conventional models, in contrast, require months to develop the tools and dies necessary in order to produce new designs.

Thus, it is now possible to build a few hundred or few thousand units of one model made with the plastic sandwich—a model quite different in design but priced competitively with traditional refrigerators offering the same capacity. As one Westinghouse executive expressed it, "Now it will be almost as easy to make a special refrigerator as a special pair of shoes."

Fabrication techniques

The two pilot plastics models introduced by Westinghouse were designed to be built directly into the kitchen wall—an innovation that blends nicely with modern concepts of a compact, yet roomy, kitchen scheme. Both models have 13 cu. ft. of capacity. One model, designed to be used vertically, has the 9-ft. refrigerator compartment at the top and the freezer compartment underneath. The horizontal model has the two compartments placed side by side and

may be installed on base cabinets of any height or attached to a wall.

In the original pilot models designed by Westinghouse, the only major components not in plastics are the steel doors, but engineers expect to have models with doors based on sandwich construction available within a year. The only problem thus far holding the development back is the method to use for effectively covering the edges of the sandwich panel where the core material shows through so that the door has a finished appearance.

Manufacture of the sandwich itself consists basically of laying the reinforced plastic skin (0.032 in.-thick) and the glossy high-impact styrene interior skin over the 2-lb.-density foamed styrene core and laminating the assembly together in a hydraulic press. Epoxy resin adhesives are used.

When delivered to the Westinghouse plant, the sandwich material is cut into a plank some 14 ft. long and about 22 in. wide, which eventually forms the top, sides, and bottom of the refrigerator body. This is accomplished by notching the "V-joints" for the corners through the inner skin and core of the sandwich (just down to the outer skin) in such a manner that the plank can be folded like a carton around the previously sub-assembled interior partitions. These partitions are also fabricated of plastics sandwich materials and are grooved so that they can be mounted together and into the main body.

Bonding with epoxy adhesives

The mitered joints which form the corners of the structure, as well as the butted ends of the plank are bonded together with an epoxy resin adhesive which is cured by radio frequency energy. This operation consists of placing the assembled basic cabinet in a positioning jig and, using special radio frequency equipment, passing 39,000 v. through electrodes in the corners for about 7 seconds. The interior partitions are bonded in place in the same manner as the corners of the basic cabinet.

The final member of the refrigerator body is the rear wall, which is also fabricated of plastics sandwich materials. Prior to assembly, the wall is edge cut, drilled, etc., to nest compactly with the basic cabinet body (which also has been edge cut to accept the rear wall). In ad-

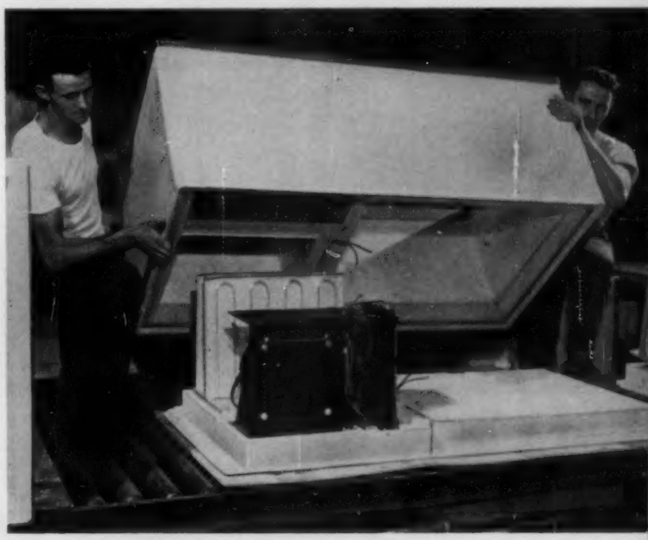


Fig. 8: Assembled cabinet body, now permanently bonded into a single, sturdy unit, is removed from the positioning jig shown in Fig. 6 and placed over assembled back panel. The two elements are screwed together

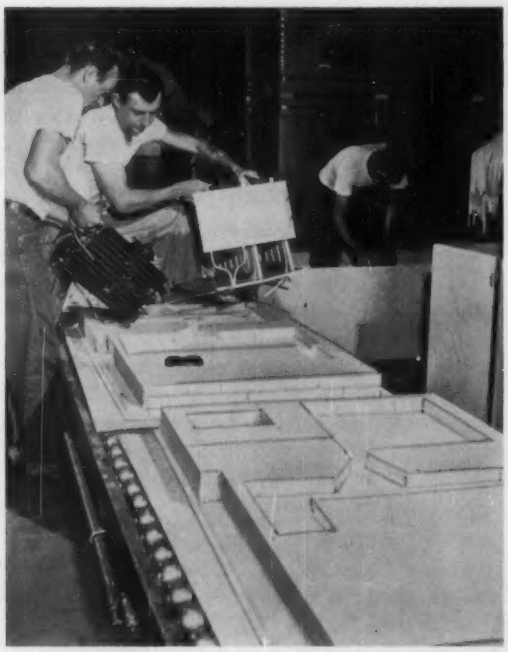


Fig. 7: Basic refrigerating units, e. g. compressor, evaporating mechanism, etc., are then inserted into the back panel in the openings cut out for them (see Fig. 5)

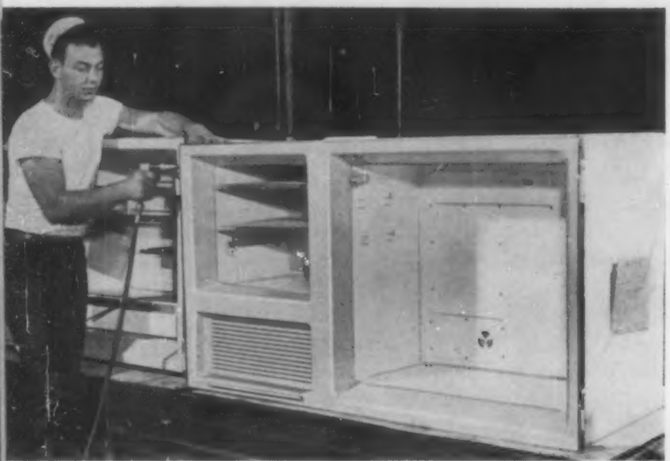


Fig. 9: Hinges for the doors are installed next. To support doors, wooden braces are set into the edges of the foamed core

Fig. 10: Assembly is completed as steel doors are hung. Next year, doors based on plastic sandwich construction will probably be used

dition, openings to accommodate the condensing system (compressor, compressor fan condenser, and refrigerating plates) are routed out of the rear wall sandwich panel and the entire system is mounted on the wall before installation. Because of the weight which the back panel thus has to carry, it is screwed, instead of adhesive bonded, to the cabinet body.

Next step in the assembly of the refrigerator is the installation of hinges for the steel doors. To support the doors, wooden braces are set into the foamed styrene insulation at the edges where the hinges are located. The breaker frame which covers the front edge of the structure is vacuum formed of high-impact styrene sheet. The frame is held in place by a stainless steel trim which embraces the outer front edge of the body; inner edges of the frame are held in place by an extruded styrene section which is mounted to the body of the refrigerator with screws.

Physical advantages

The advantages to be derived from using the sandwich construction in refrigerator design are many. As described above, the ease with which the material can be worked makes it especially adaptable to custom-type built-in refrigerators. Uses of this kind are specialized, so the quantities needed of any particular model are much less than for conventional free-standing units.

Weight of the new refrigerators is, of course, considerably less. Even with steel doors, the units average 150 lb. less weight than steel models with the same cubic capacity.

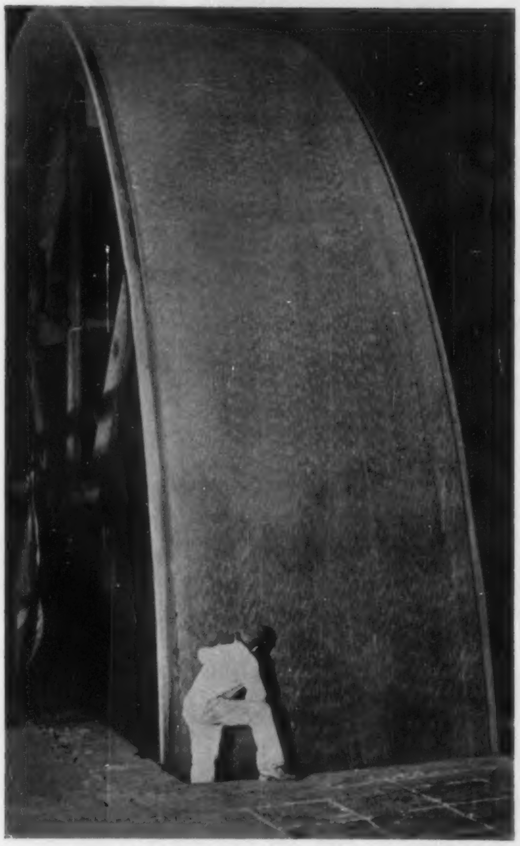
The strength of the new units is also an outstanding feature. Because of the structural advantages inherent in sandwich construction, Westinghouse engineers believe that ultimately refrigerator walls made with this material can be thinner than is now possible. This will lead to more compact units and more efficient use of space.

Finally, the rigid foamed styrene insulation, since it is moisture resistant, and never settles, will retain its original insulating efficiency indefinitely. On the other hand, the efficiency of insulation in standard refrigerators (generally, fibrous glass materials) may decline as the material absorbs moisture and settles.

Thus, the success of the all-plastics refrigerator may well prove the deciding factor in ushering in a new era of appliance design and construction. Moreover, the publicity attendant upon its introduction has already aroused the interest of other industries, particularly food processing plants, bakeries, trucks and railway cars, and building, as to the potentials inherent in strong, lightweight, and easy-to-fabricate plastics sandwich constructions.

Credits: The plastic refrigerator is a development of Westinghouse Electric Corp., Electric Appliance Div., Columbus, Ohio; Hasko-Struct sandwich material supplied by Haskelite Mfg. Corp., Grand Rapids, Mich.; Styrofoam foamed styrene insulation by The Dow Chemical Co.

Nylon drives heavy industry



Largest nylon rolling-mill drive belt, installed in Belgian iron works. Diameter of the flywheel is almost 100 feet

European heavy industry has started to switch to vinyl-coated nylon as a drive-belt material.

Highlighting this trend is the recent installation in a major Belgian iron mill of perhaps the largest Perlon nylon rolling mill belt ever produced: it is made of $\frac{9}{16}$ in. material and is 190 ft. long. The belt transmits up to 500 hp. from a motor with 100% overload capacity to a flywheel of 92.5-ft. diameter.

This giant belt is unique only insofar as its size is concerned. The use of vinyl-coated drive belts is growing increasingly common. Equipment on which they have been used to date include compressors, generators, mine fans, hollanders, and others.

The nylon belts are coated with vinyl by a special technique which assures that the final surface of the belt is completely smooth and uniform.

Both heavy-duty and high-speed belts are available. Among the latter are some as small as 1.5 ft. in length which have given continuous high-speed service at rates as high as 330 ft./second.

By thus combining nylon and vinyl in drive belts, operations in industrial firms using the belts have been improved. Each of the materials contributes important benefits.

1) Rolling mill drives are subject to heavy jolting loads. The nylon belt, because of its good elasticity characteristics, absorbs all impact and keeps it away from the bearings.

2) Once mounted, belts never need be shortened to compensate for stretching. A leather belt previously used at a foundry had to be shortened a total of 38 times.

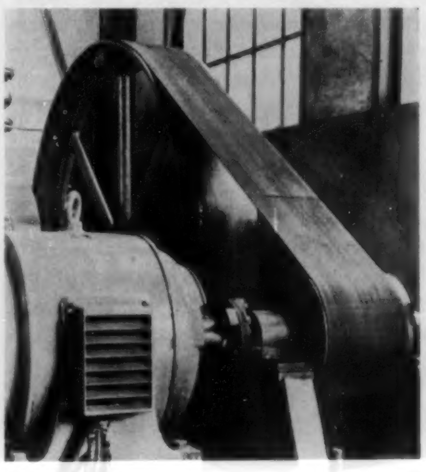
3) Tear and bending strength of the belts are far superior to other belting of the same thickness. Thinner belts can thus be used.

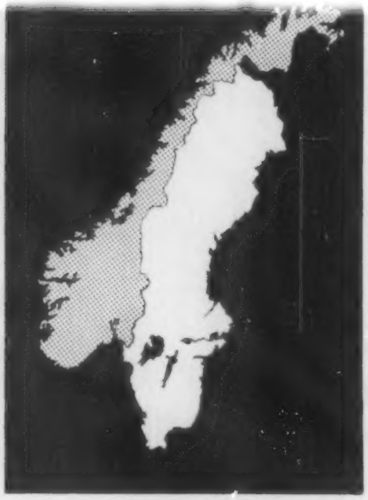
4) Thinner belts have better traction, not only providing improved high-speed operations, but also eliminating the need for commonly used belt bracing.

5) Belt deterioration is greatly reduced. The vinyl coating on the nylon belt provides good resistance to many acids, alkalies, gasoline, oil, moisture, and other contaminants.

6) Since the PVC coating is not tacky, the incidence of encrustation on belt and pulleys is either reduced or completely eliminated.

Compressor drive belt of vinyl-covered nylon; 200-hp. motor develops a belt speed of 80 ft./sec.





SWEDEN: fast increase in consumption

*By Jan-Erik Janson**

The plastics industry in Sweden is growing much faster than any other. In a recently published survey of the Swedish chemical industry, the production of plastics materials in 1954 was estimated at 27,800 metric tons—an increase of about 100% from 1950, when it was about 14,500 tons. The production volume for 1955 is estimated at about 31,000 tons. The corresponding import volume in 1955 is estimated to have been about 16,000 tons, while the export figure on this group of materials was around 6000 tons. A metric ton is 2204 pounds.

Altogether there are between 600 and 700 companies directly or indirectly connected with the plastics industry.

Perhaps the best way of outlining a picture of the industry is to discuss first the manufacturers of raw materials, then the processing field and, finally, machinery and equipment.

Thermoplastic materials

Acrylic plastics are manufactured by one company, AB Bofors Nobelkrut, which has a limited production of cast sheets; a larger share of the company's production is devoted to acrylic resin emulsions and dispersions for use in the paint and varnish industry, the textile industry, etc. But since this company also has a fabricating department that absorbs most of its production, the consumption of acrylic sheets has to be covered by import; the import in 1955 was about 400 tons, with Great Britain and Western Germany supplying most of the material.

Of the cellulosic plastics, i.e., those based upon esters, mixed esters, and ethers, there is no production in Sweden today, except for some water-soluble cellulose ethers which are sometimes regarded as plastics. During the war and some years thereafter there was a small amount of ethyl cellulose produced. One company has a rather large production of nitrocellulose for lacquer purposes, part of which is exported.

In the field of water-soluble cellulose ethers, two companies—Svenska Cellulosa AB, Sundsvall, and Uddeholms AB, Skoghallsverken, Skoghall—are manufacturing carboxy methyl cellulose (CMC) and a third company—Mo & Domsjö AB, Kemiska Industrierna, Stockholm—is manufacturing ethyl hydroxyethyl cellulose. The total production of these cellulose ethers is estimated at about 2500 tons.

Fluorocarbons, polyamides, and polyethylenes are not yet being produced in Sweden, but all of them are being processed. For the import of fluorocarbons no figures are available, but import of nylon molding materials in 1955 was about 95 tons, an increase of approximately 100% over 1954. The consumption of polyethylene shows a very fast growth, import in 1955 being nearly 2300 metric tons, with Great Britain, United States, Canada, and Western Germany serving as main suppliers. In 1954 polyethylene import was only about 1000 tons.

Styrene plastics are manufactured by Svenska Chemaco AB, Kävlinge, which is a licensee of Koppers Co., Inc., U.S.A., and has a technical cooperation arrangement with that company. The production program includes normal polystyrene as well as the high-impact and modified types and also materials for foamed polystyrene and styrene emulsions. Production capacity is estimated to be about 1800 tons, but because of heavy competition from abroad on the Swedish market as well as in the export markets, presumably only about 1200 tons were produced in 1955. The import that year

*Executive Secretary, Swedish Plastics Federation.

was 1087 tons with Western Germany, Great Britain, U.S.A., and Canada as main suppliers. This compares with an import of only 660 tons in 1954. The export of styrene plastics in 1955, at 444 tons, showed a slight increase over the 417 tons shipped out in 1954.

The vinyl plastics industry is very well developed in Sweden and the Swedish manufacturer of polyvinyl chloride, Stockholms Superfosfat Fabriks AB (Fosfatbolaget), Stockholm, has a capacity which also allows some export. During 1954 and 1955 the production facilities were increased to about 6000 metric tons yearly and it is believed it will be further increased to about 7000 tons in 1956. As the company is producing only some of the many different types and qualities of vinyl chloride polymers and copolymers now commercially available around the world, some types have to be imported. Thus, the import of vinyl in 1955 was about 3000 tons (dry resin), with Great Britain, Western Germany, and Italy as main suppliers. In 1954 it was 3100 tons. Vinyl export was about 1075 tons in 1955 as compared to 975 tons in 1954.

Synthetic fibers are not usually regarded as belonging to the plastics field, but it may be noted in this connection that one company, Stockholm Superfosfat Fabriks AB (Fosfatbolaget), has for some time had a pilot plant running for the production of acrylonitrile fiber. It is not known when commercial production will start.

Thermosetting plastics

Since 1919 phenolics have been produced in Sweden, and today the three main thermosets are made.

In the amino plastics field three companies —Stockholms Superfosfat Fabriks AB, Skanska Ättikfabriken AB, Svenska Oljeslageri AB—are manufacturing various types of melamine and urea resins, also modified, for the paint and varnish industry.

The production of urea resin adhesives is carried out mainly by two companies, AB Casco, and Stockholms Superfosfat Fabriks AB, and on a smaller scale by a third company, Stockholms Benmjölsfabriks AB.

Melamine molding powders are manufactured by Stockholms Superfosfat Fabriks AB and for their own consumption also by Skanska Ättikfabriken AB and ASEA. Skanska Ättikfabriken AB and Fosfatbolaget are both manufacturers of urea molding powders.

Total production of amino plastics (counted as dry resin) for 1955 is estimated at 5900 tons and for 1956 at 6500 tons. These figures include resins for the paint and varnish industry, adhesives, molding powders, and laminating resins.

The import of amino resin adhesives has in recent years continued to decrease because of the heavy competition the Swedish manufacturers are in a position to show. For 1955 it was about 1000 tons (as dry and liquid adhesives), while the corresponding export figure was about 1400 tons. The total Swedish production of amino resin adhesives in 1955 was about 4000 tons (dry resin content). Import of amino plastics molding powders in 1955 was about 320 tons, with Great Britain and Western Germany the two major suppliers. This represented a slight increase over earlier years, but it is interesting to note that the import figure for amino plastics molding powders has been fairly constant, about 250 to 300 tons, since the war. The export of these molding powders has been on the increase during recent years. In 1954 it was 864 tons and in 1955 it was 943 tons.

If the amino plastics field is difficult to illustrate with statistical data, the situation is even worse in the phenolics field. Phenolic resins of various types for the paint and varnish indus-

Presented here are the 10th and 11th articles in the series "Wide World of Plastics" which started in our May issue.

These authoritative articles are written by plastics publication editors or industry leaders. The purpose of the series is to show the progress of plastics throughout the world.

In each succeeding issue, countries not checked in the list at the right will be represented.

Argentina ✓
Australia ✓
Belgium ✓
Brazil
France ✓
Germany (West) ✓
Great Britain ✓
Holland ✓
India
Israel ✓
Italy ✓
Japan ✓
Luxemburg ✓
Mexico
Norway ✓
Puerto Rico
Spain
Sweden ✓
Turkey

✓ Covered in this issue
✓ In previous issues

Polyethylene-coated paper milk container of unusual tetrahedral design, just now being introduced in this country, was originally developed in Sweden

try and phenolic industrial resins are manufactured by the following companies: AB Klosters Fabriker, Skanska Ättikfabriken AB, Svenska Oljeslageri AB, Bergviks Hartsprodukter AB, AB Casco, and ASEA, the last mentioned company mainly for its own consumption. Phenolic molding powders are manufactured by three companies: AB Klosters Fabriker, Skanska Ättikfabriken AB, and ASEA. One of these firms, Skanska Ättikfabriken AB, had a serious explosion in its molding powder plant in 1954, causing a heavy decrease in its production. This, in turn, was reflected in an increase in imports.

Technical grades of paper- and fabric-based phenolic laminates are manufactured by Skanska Ättikfabriken AB, Nya AB Resinit, Västervik, and ASEA, while decorative laminates are manufactured by Skanska Ättikfabriken AB and AB Tilafabriken with a third company, Torsviks Sagverks AB, coming into production probably later this year. Skanska Ättikfabriken AB has a mutual exchange of technical cooperation with St. Regis Paper Corp., in the United States, and AB Tilafabriken has a similar arrangement with the Arborite Co. Ltd., Montreal, Canada. The decorative laminates made by Skanska Ättikfabriken AB and sold under the trade name Perstorpsplattan are one of the biggest sales successes in the Swedish plastics industry and this material also represents one of the biggest single groups of materials exported. Thus the total export of phenolic laminates including decorative laminates in 1955 was 1210 tons as compared to 689 tons in 1954 and 394 tons in 1953. The corresponding import figures are 590 tons in 1955, 330 tons in 1954, and 103 tons in 1953. The import consists mainly of technical grades with Western Germany, Great Britain, and Denmark as the biggest suppliers.

Phenolic resins

Import in 1955 of various types of phenolic resins, also modified, including paint and varnish resins and various types of industrial resins was about 440 tons, most of which was supplied by Western Germany, Holland, and the United States; export was 169 tons. The import of phenolic molding powders, which in 1954 was 809 tons, increased in 1955 to 1733 tons. The export in 1955 was only 55 tons, compared with 106 tons in 1954. An important use of cresol and phenolic resins in Sweden is for the treatment of rock wool. This is carried out primarily by two companies, AB Statens Skogsindustrier at Laxa Bruk, Laxa, and AB Rockwool, Skövde. Both companies manufacture their own resins.

Total production of all phenolics for 1955 (dry resin content) is estimated to have been about 3550 tons. For 1956 it is believed to be about 3750 tons.

Two companies, Svenska Oljeslageri AB, and AB Syntes, are manufacturing unsaturated polyester resins for the reinforced plastics industry. No data concerning production, imports, or exports are available because these resins are included under other headings, but it is believed that the current consumption of polyesters is about 500 tons, most of which is supplied by the domestic manufacturers. One company, ASEA, has a limited production of alkyd molding compounds.

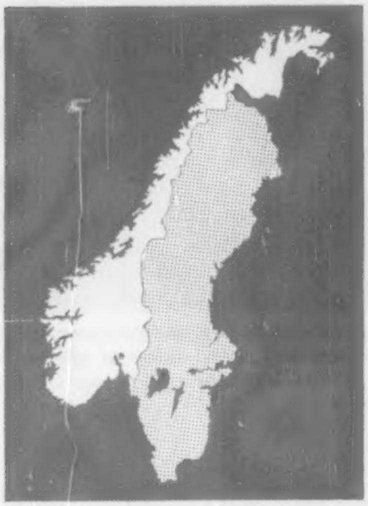
Epoxy plastics are not manufactured in Sweden, but some companies are importing resins which are being modified in the country for various purposes, mainly the paint and varnish industry. Epoxy resin adhesives and potting compounds, which are imported, are beginning to find use.

Two companies, both of which are manufacturing phthalic anhydride, are also manufacturers of phthalate plasticizers: Svenska Oljeslageri AB and AB Syntes. One company, Uddeholms AB, Skoghallsverken, Skoghall, is manufacturing phosphate plasticizers. The production of phthalate plasticizers is rather large in volume, but no data are available. However, the export figure for 1955, 2408 tons, is a volum indicator. The corresponding import figure was 1038 tons. Import of phosphate plasticizers was 66 tons and the export figure was 75 tons in 1955.

Fillers such as wood flour and alpha-cellulose, are produced by several companies in large quantities and are also being exported. In the last few years one company, ASEA, has started to manufacture fibrous glass at a plant in Robertsfors. At least one company, Mölnlycke Väfveri AB, Gothenburg, is manufacturing glass cloth.

The Processing industry

Some of the semi-finished plastics products in Sweden, such as laminates, have been dealt with above because of the fact (*To page* 232)



NORWAY: obstacles being overcome

*By Hans J. Knap**

Plastics, Norway's youngest industry, has expanded rapidly in the last decade, in spite of the fact that most processing machinery and much material has had to be imported during a difficult exchange situation.

In the 1930's there were only about a dozen molding and fabricating plants in Norway; today, there are at least 200, producing a wide variety of plastics products and parts.

Compression and transfer presses, injection molding machines, extruders, calenders, and vacuum forming equipment are practically all imported—but molds and dies and other tools are made in Norway.

As regards raw materials, Norway is producing more and more each year, but, at present, the supply is not nearly enough to satisfy the needs of the industry. Raw materials are produced only by a few large firms in the chemical and cellulose industry. And production is rapidly expanding.

Production of polyvinyl chloride is presently about 2500 tons per year, of which about 1000 tons are used within the country (500 tons by the cable industry alone); the rest is exported. Vinyl output will be doubled this year, and polyvinyl acetate emulsions will also be turned out for the textile, paper, and paint industries. Vinyl acetate monomer will soon be made in Norway.

Urea is produced in large quantities, largely for adhesives and industrial resins; part also goes into plasticizer production. Both phenolic resins and molding materials are made in quantities to more than cover demand.

Imports of plastics raw materials in 1954 were valued at about $4 million; in 1955, at about $6 million. Exports in both those years ran a little over $1 million.

*Secretary, Norsk Plastforening, Oslo.

Better conveyor belt

Paper-thin conveyor belting for carrying candies through cooling tunnel is fabricated of tough, flexible polyester film laminate; glossy surface of film provides glossy finish for chocolate coatings. (Photos, Du Pont)

To those manufacturers in the food processing industry who collectively spend millions of dollars annually on conveyor belts, the emergence of Mylar polyester film as a successful belting material is being regarded as one of the most economical and effective answers yet devised for solving the industry's production line headaches.

Plastics have long had their eye on this lucrative food conveyor market. In the candy industry, alone, it is estimated that the more than 3000 candy manufacturers in this country spend about $1.5 million annually on belting for cooling-tunnel conveyors. In the baking industry, 8000 bakeries spend an annual average of $500 apiece on conveyor materials. And other segments of the food field report similar impressive figures.

In trying to drive a wedge into this profitable food conveyor market, most plastics applications have heretofore been limited primarily to plastics-coated or impregnated fabric belts. With the introduction of polyester film belting, however, the industry believes it has at last found a basic material combining all of the qualities that are desired in conveyor belts of this type.

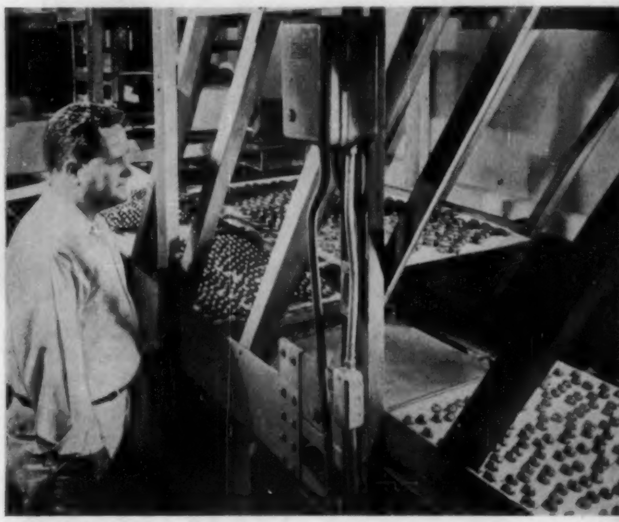
Basic advantages

As a belting material, polyester film is strong enough to be applied directly on the conveyor, without the need for any underlying core or fabric support, and will perform effectively over long periods of time with little or no sign of wear. The film has an exceptionally smooth surface and consequently is easy to clean. In addition, it is flexible, crackproof, non-absorbent, immune to attack by oils and greases, stable under temperature and humidity changes, and a good heat transfer agent. Because of its low areal density, 0.04 lb./sq. ft. polyester film belting is only 1/12 as heavy as the lightest woven material. This means that less power is required to drive equipment and consequently there is reduced strain on machinery.

for foods

is a lamination of two sheets of transparent polyester film, using a special white adhesive

In the candy industry, laminate can also be used as long-wearing plaques which are laid flat over a fabric conveyor belt



Plaques, with candy on them, can then be transferred intact to vertical-traveling conveyor which carries them into cooling tunnel

From the standpoint of economics, the simple design of the polyester film belting and the ease with which it can be installed can be translated into important savings. Basically, the belting consists of two 3-mil sheets of transparent polyester laminated together with a white-pigmented adhesive.

The belting is supplied already cut to size to the end-user. One end of the belting is cut on a 45° bias to enable the two sheets which make up the laminate to be pulled apart and back for a distance of about 2 in. from the end. When the belt has been fitted into place on the conveyor, the end of the laminate which has been left intact is inserted between the two separated sheets at the opposite end. The assembly is then sealed with a liquid polyvinyl acetate adhesive supplied by the manufacturer. A 2 in. wide pressure-sensitive tape with a ½ mil thick transparent polyester film backing is applied over the joint to give a final smooth finish that is not affected by scraping or cleaning. Thus, the food pro- (*To page* 244)

Film belt (sample, left) can be used for carrying hot doughnuts. Previous fabric belt deteriorated on contact with cooking oils

Shells for lightweight two-suiter are formed in one piece of styrene copolymer sheet—no seams to mar the streamlined design. (Photos both pages, Regal)

While styrene copolymer sheet has long been recognized as having outstanding potentials as luggage material, it has only been within the past few months that the idea has really taken on an aspect of healthy and exciting competition. Just recently, within a matter of days apart, three manufacturers—Regal Plastic Co., Kansas City, Mo., Boyle Leather Goods Co., Inc., New York, N. Y., and U. S. Trunk Co., Fall River, Mass.—came out separately with new lines of luggage based on U. S. Rubber's Royalite sheeting and at least one-half dozen others are reportedly in advanced stages of research on possible large-scale applications.

According to luggage manufacturers, all this excitement is well warranted. The luggage field right now is in one of the greatest periods of expansion in its history—and formed copolymer sheet luggage seems destined not only to benefit from this growth but also to contribute strongly to furthering it. Ever since 1948, when the industry went into a slight decline, luggage

Luggage is going places

Neat inside lining for two-suiter (right) is formed to soft styrene copolymer sheeting in 3-D weave pattern. Lining is adhered to top edges of shell (cross-section below). Metal frame (arrow) reinforces edges and serves as a mounting platform

sales have been on the upswing. This year, the retail sales value of luggage is expected to be about $200 million—equalling the record year of 1947. Prospects for 1957 look even brighter. The rate of travel, which is the key to luggage sales, has been multiplying rapidly over the past five years. In 1955, alone, some 85 million Americans traveled away from home. Next year, lower transportation costs, faster transportation facilities, and increased leisure time will push the travel rate—and consequently sales of luggage—even higher.

Plastics in the luggage field

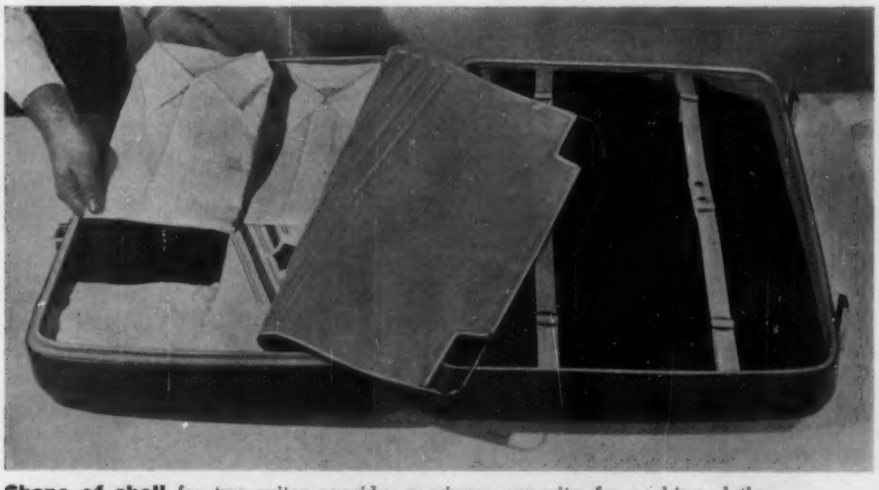
Plastics as such are no strangers to this lush market. In that area of the luggage field known as "soft-side luggage" (e.g. flexible garment bags, etc.), vinyl sheeting and various plastics impregnated or coated fabrics have long been in use; in "hard-side luggage" (rigid wardrobe cases, etc.), wooden boxes covered with vinyl sheeting or plastics coated materials are fairly standard.

More recently, molded plastics luggage formed under heat and pressure to a desired shape (instead of being fabricated from sheeting) has set new standards of quality. Match metal molded reinforced plastics luggage is one example of this new concept in design. And in 1954, a new line of luggage was introduced in which embossed vinyl sheeting was bonded under heat and pressure to a contour shell molded of a resin-impregnated cellulose fiber-fibrous glass preform. (See "Production-line luggage," MODERN PLASTICS 32, 102, Oct. 1954.)

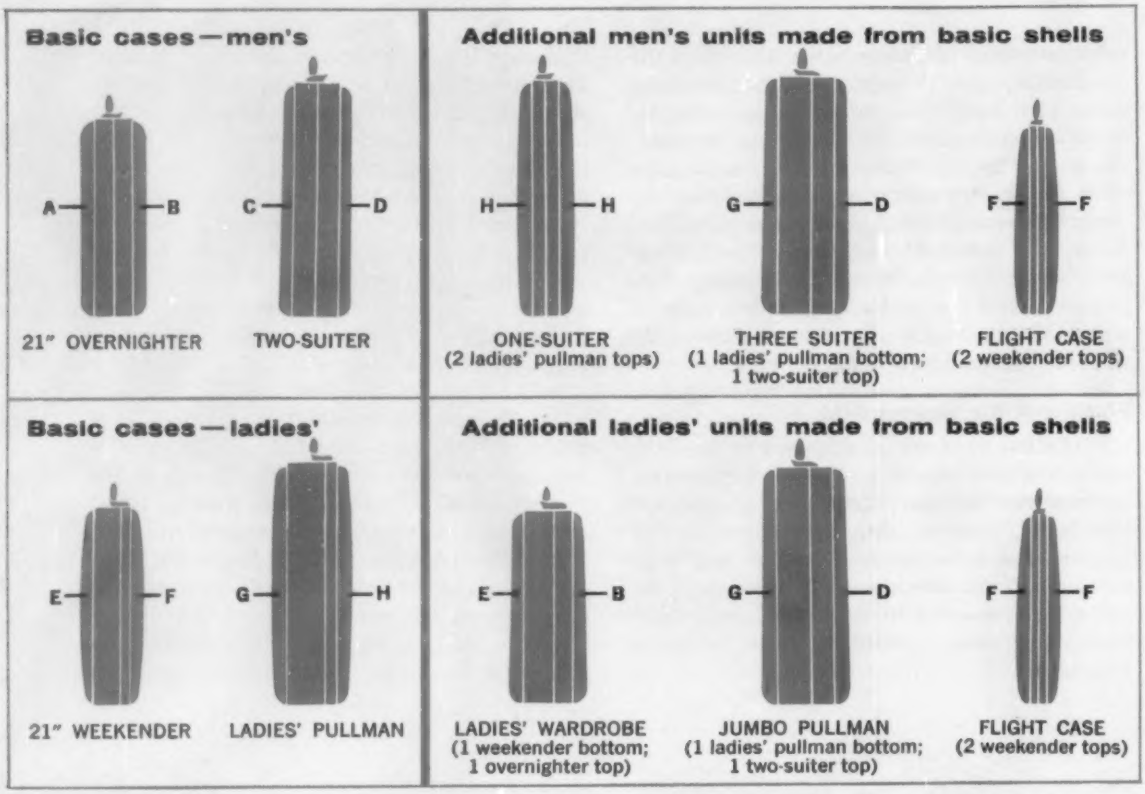
Now, with the introduction of the Royalite luggage, comes still another concept in luggage design—a concept that shows definite signs of revolutionizing the traditional makeup of the luggage industry. On one hand, luggage based on styrene copolymer sheet construction comes into direct competition with "soft-side luggage," particularly those leather goods (two-suiters, etc.), where the leather is stretched over a frame to effect a semi-rigid construction. On the other hand, the tough, rigid copolymer

with copolymer sheet

New concept in luggage construction is based on shells and coverings formed of tough styrene copolymer sheet



Shape of shell for two-suiter provides maximum capacity for packing clothes. Formed mating flanges which provide perfect closure are integral with each shell



Formed shells for the four basic cases planned for Regal's luggage line are engineered so that the basic shells in varying depths can be combined to make additional models for the line. Two top shells (H) from a ladies' pullman case, for example, combine to make a one-suiter for men. (Sketches, Regal)

sheet luggage is equally as ideal for "hard-side" goods which require more solid construction.

The over-all advantages of the new plastic luggage are many. In contrast to leather, styrene copolymer sheeting is more durable and longer lasting. Because the sheet is formed in one piece, there is no need for stitching or pasting which could weaken the luggage in corners or edges. In addition, the plastic resists stains, moisture, grease, mildew, and vermin; it is scuffproof to withstand the rigors of travel; and it is easy to clean. Today's emphasis on air travel, with its restrictions on luggage weight, makes the lightness of the styrene copolymer sheet (sp. gr., 1.12) a distinct advantage. Also of major importance is the variety of colors and grain textures in which the sheet is available and its adaptability to formed one-piece streamlined design—with no unattractive joints or seams to mar its graceful lines.

Formed all-plastic luggage

The Regal-Aire flight-weight luggage announced by Regal Plastic Co., Kansas City, Mo., differs from other products on the market in that the *entire* case, including shells, linings, compartment covers, straps, etc., is fabricated from styrene copolymer sheeting—both in rigid and elastomeric form. This triumph in "engineered" luggage—as handsome a piece of goods as it is practical—is the result of many years of development work on the part of materials supplier and fabricator.

As far back as 1949, Regal, in common with other manufacturers working with styrene copolymer sheeting, realized the potential of the material in the luggage field. But while hesitant gestures were made in this general direction, full development of the application was stymied by two factors: 1) the relatively high cost of the sheeting and 2) the difficulty of effecting a closure by applying male and female metal edgings to the mating edges of the formed plastic shells.

This year, however, improved production processes enabled U. S. Rubber to cut the price of Royalite down to a more competitive level. And by this time, work done by Regal in turning out a formed case for the Dictaphone Corp. (see "Engineering a new case," MODERN PLAS-

TICS 32, 113, July 1955) provided the clue to the "missing link" needed to successfully adapt solid styrene copolymer sheet to luggage design—integral mating flanges formed directly into the one-piece shells. When applied to the new luggage, this design completely eliminated any necessity for metal edgings. In the finished piece, all that is required to structurally reinforce the mating sections is a concealed aluminum frame which rests on the inside ledge of the shell (see cross-section photo, p. 126); the metal frame also serves as a solid base for the attachment by rivets of the hardware, handle, hinge-bumpers, etc.

Since the mating edges must be turned out to close tolerances, vacuum and pressure, as well as mechanical assists, are used in the forming operation. Each shell is formed in a female mold from a sheet of Royalite, $\frac{3}{16}$ in. thick.

Flexible styrene copolymer lining

Fabrication of the lining which Regal has adopted for use in its new line represents another important step forward in the application of plastics to the luggage field. Instead of using a conventional cloth lining which can tear, stain, or become soiled in one way or another, Regal forms the lining in one piece of elastomeric Royalite—the same type of resilient, tough material being used by the automotive field today in crash pad applications. The tailored, suede-like lining is formed with a criss-cross raised pattern that adds an element of eye-appeal to its functional advantages. It is permanently installed inside the shell by cementing the edges of the lining to the top of the shell—a technique which also serves to cover up the rough edges of the mating sections. (See cross-section photo, p. 126.)

To complete the all-plastic construction, even the compartment cover in the top half of the luggage and the straps in the bottom half (see photo, p. 126) are fabricated of the same resilient material. The result—a high-quality piece of luggage as attractive inside as out, as long wearing inside as out, and as easy to clean inside as out.

At the present time, Regal expects to produce only a 21 in. men's case and a men's two-suiter, using the all-plastic construc- *(To page 248)*

Line of portfolios (by Boyle) consists of identical shells formed of styrene copolymer sheet and joined by a zipper web. By varying width of web and by fitting the interior of the case with proper pocket arrangements (bottom), full line is available from a single size shell. (Photo, U. S. Rubber)

Die-cut decal-type vinyl motifs with pressure-sensitive adhesive backing are ideal for the do-it-yourself decorator market. (Photo, Cohn-Hall-Marx)

Self-adhesive vinyl motifs

Die-cut printed vinyl motifs with a pressure-sensitive adhesive backing are reviving the interest of the housewife in decal-type decoration. At one time very much in vogue for applying small areas of color or design to walls and furniture, conventional paper decals have in recent years gone out of style—primarily because of problems associated with application and removal. To apply paper decals, moistening is generally necessary (with the consequent danger of staining delicate surfaces) and, once applied, the paper decals can be removed only by scraping and scrubbing.

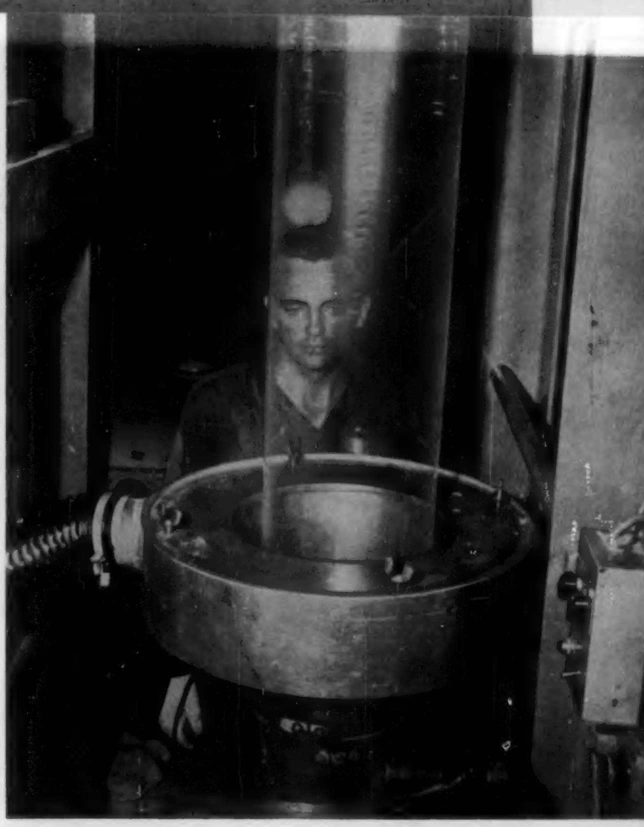
The self-adhesive vinyl decals, by eliminating both of these problems, are expected to bring this type of do-it-yourself home decorating technique back into style—and its success can conceivably hold the key to an even more extensive use of the material for shelf edging and household trim.

The die cut vinyl motifs offer the same advantages that have made self-adhesive vinyl wall coverings and decorator materials so popular in recent months. They are stainproof, abrasion and moisture resistant, and easy to wipe clean with a damp cloth. To apply the decals to any dry, clean, smooth surface, the protective paper backing on the adhesive side of the decal is simply peeled off and the decal is pressed into place. If removal or replacement of the decals is desired, they can be stripped off quickly without leaving marks.

Two suppliers of self-adhesive motifs—Cohn-Hall-Marx Co., New York, N. Y., and Patrice, Inc., New York, N. Y.—already have available for consumer use a wide range of designs—from flowers to nursery rhyme characters. Each motif is die cut out in exact register so that additional trimming is unnecessary.

Credits: Ultron vinyl film for Cohn-Hall-Marx's Contact Cut-Outs supplied by Monsanto Chemical Co.; Velon vinyl film for Patrice's Decores supplied by Firestone Plastics Co.

Motifs can easily be pressed into place by hand and just as easily stripped off when a change in decor is desired. (Photo, Firestone)



Nylon-6 film being produced on standard polyethylene equipment can be drawn down to 0.2 mil. (Photo, Spencer Chemical Co.)

New markets for nylon-6

*By Mark Stringfellow**

Nylon molding material is gradually assuming a highly important role to molders and users in the United States, even though volume is still small compared to that of lower-cost materials. However, there is evidence to support the belief that growth may increase more rapidly in the next 10 years than it has since the material first became commercially available seven or eight years ago.

Until now, nylon has been used primarily as an engineering material, but technicians and market researchers are convinced that broader markets will open up as experience is gained in fabricating and using nylon materials. Among their reasons for this conclusion is the advent of nylon-6, which until a year and a half ago, was scarcely known in the United States, although broadly used on the European continent. Nylon-6, made from caprolactam monomer, differs from the Du Pont product nylon-6/6 in several respects. It is the purpose of this article to point out how those differences may possibly be used to broaden the base for use of all nylon in the future.

Until about one and one-half years ago, domestic production of nylon came from Du Pont only. At that time, the Barrett Div., Allied Chemical & Dye Corp., became the second domestic source of supply, but with nylon from caprolactam rather than the Du Pont type. Recently, Spencer Chemical Co. also made known its plans to enter production of nylon molding resins from caprolactam monomer with a "modest-size" plant to be built at its Henderson, Ky., works. Another recent entry into the caprolactam nylon field is Foster Grant Co. Du Pont also supplies a nylon-6 material. In addition to these domestic sources of supply, some competition is expected to come from European producers. A summary of the producers, sales agents, and resin types sold is shown in Table I, p. 132.

*Director of Sales Development, Spencer Chemical Co.

Present end uses

Price has generally confined most current uses of all types of nylon to quality work where the premium can be paid.

Nylon has always been a material that required expert molding techniques. Older types of nylon had a low melt viscosity, that is, at molding temperatures the resin flowed much like water and much too freely to be handled with simplicity and ease. This property has been a contributing factor to nylon's heretofore modest growth.

There are now three important types of nylon used for molding resins: nylon-6/6, tradenamed Zytel 101 by Du Pont, which has been the well-established compound responsible for

Oil carrying can is assembled by heat-sealing two molded nylon-6 parts together. (Photo, Algemene Kunstzijde Unie, N.V.)

Molded nylon lid for sugar mill centrifuge weighs 7 lb., replaces 40-lb. steel cover. (Photo, Steon, Holland)

most of the market growth; nylon-6, which has been developed largely in Europe and is basically somewhat a softer material than 6/6; and nylon-610, which is produced largely for the monofilament or bristle market and military wire coating.

Table II, opposite, compares molding properties of nylons-6 and 6/6. Nylon-6, as a softer material, has a lower melting point and a broader working temperature range when molded. It is reported that the temperature range for nylon-6/6 is about 30° F.; for nylon-6, it is about 70° F. Thus nylon-6 requires less heat and can give higher machine productivity when the plasticating rate limits output. For extrusion, viscosities of both are comparable, but there is still a 50° F. difference in working temperatures. Nylon 6/6 is harder and stronger with greater heat resistance.

Until recently, few items have been made that required more than several ounces of nylon. There is not a single nylon molding end-use application which commands a multi-million-lb. market. This is clearly brought home in the automotive field, which uses about ½ to ¾ lb. per car (particularly in General Motors and Ford models), in a number of applications that are scattered throughout the automobile. Many of these parts may be produced at the rate of several per pound, and in some instances at the rate of over 100 per pound. Proven applications for nylon are vast in number, but few require large poundage. Table III, p. 135, illustrates what is believed to be a reliable estimate of nylon resin growth in the period 1950-55. It is interesting to note that the largest consuming segment of nylon is devoted to "engineering parts."

Nylon growth potentials

Unusual strength, hardness, and self-lubrication properties should be the basis for increased consumption of nylon as an "engineering material." It will continue to enter fields of application which have been traditionally re-

Table I: Sources of nylon molding resins marketed in the United States

Trade name	Zytel	Plaskon	Spencer nylon	Durethan	Grilon	Ultramid
Manufacturer	Polychemicals Dept., E. I. du Pont de Nemours	National Aniline Div., Allied Chemical & Dye Corp.	Spencer Chemical Co.	Farbenfabriken Bayer AG Leverkusen, Germany	Holzverzuckerungs AG Zurich 1, Switzerland	Badische Anilin & Soda-Fabrik AG Ludwighafen, Germany
Sales agent	Polychemicals Dept., E. I. du Pont de Nemours	Barrett Div. Allied Chemical & Dye Corp.	Spencer Chemical Co.	Hercules Powder Co.	Alfred C. Toepfer, 1 Broadway N.Y. 4, N.Y.	Nova Chemical Corp., 147-153 Waverly Pl., N.Y. 14, N.Y.
Types	Nylon 6, 6/6, and 610	Nylon 6	Nylon 6	Nylon 6	Nylon 6	Nylon 6 and 6/6
Grades	11	2	8	1	6	3

served for metals. Initial cost of nylon is several times that of many metals, but nylon has only a fraction of the density of these materials. Thus, savings, on the basis of low density (more parts can be made per pound), partially compensate for the high cost of molding resins. Nylon thus compared with metals as far as the volume of finished goods (in cu. in.) that can be turned out per each dollar spent on material cost shows up favorably. There is also an attractive cost savings implied by the fact that parts can be injection molded directly to close tolerances, as compared to metal fabrication techniques, involving casting or stamping, followed by secondary machining operations. Here, too, the knowledge that nylon will outwear, by several times, many metals, provides another basis for predicting future increased use.

Key industrial and engineering personnel predict that at a price somewhat lower than its present level, nylon will become directly competitive with die cast zinc on a cost basis. The ½-billion lb. annual consumption of die cast zinc offers growth opportunities which nylon molders and raw material producers have eyed hungrily for some time.

One of the largest users of die cast zinc parts is the automotive industry, e.g. radio grills, instrument panels, carburetor parts, bodies for fuel pumps, heater components, etc.—all of which are now potential applications for nylon. The electrical industry also produces numerous die cast zinc parts for washing machines, motor housings, and vacuum cleaners. Business machines and other light machines, such as typewriters, cash registers, sewing machines, and gasoline pumps, use a host of die cast zinc parts.

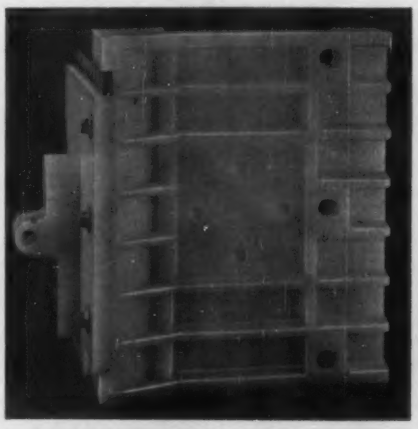
Table II: Comparison of properties for nylon molding resins

	Nylon 6	*Nylon 6/6*
Greater hardness		x
Higher impact strength	x	
Higher melting point		x
Higher melt viscosity	x	
Shorter molding cycles		x
Greater abrasion resistance		x
Greater moldability	x	
Less brittle	x	
Greater flexibility	x	
Less shrinkage	x	
Greater heat resistance		x
Comparatively poor electrical properties	x	x

Here at Spencer we believe that perhaps two of the most significant developments in nylon are: 1) caprolactam or nylon-6 resins which permit production of parts having large surface area and also parts with thicker cross sections and 2) development of high-melt-viscosity resins for making nylon pipe, film, and bottles.

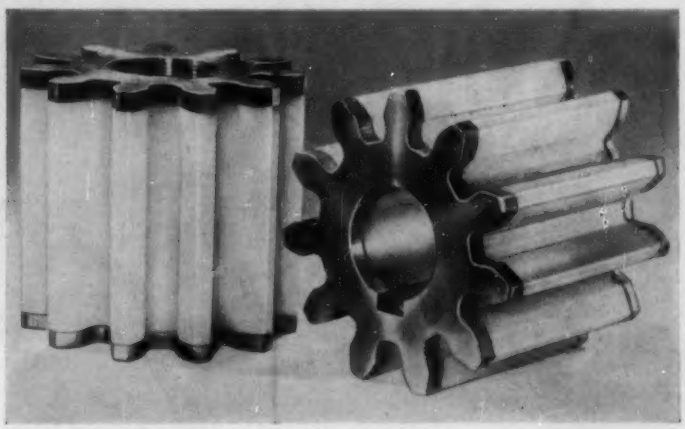
Injection molding

Progress of nylon-6 has been made toward producing parts requiring pounds rather than ounces, based on resins which have both wide plasticating and temperature working ranges. A resin with narrow plasticating range and narrow working temperature range solidifies

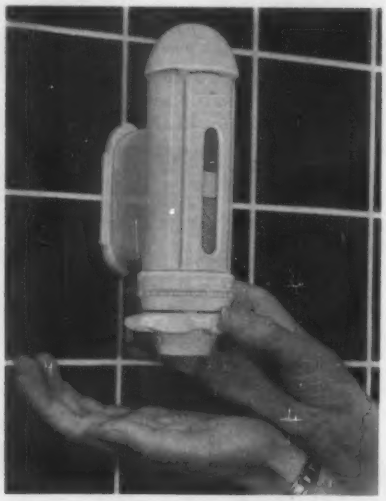


Lightweight molded nylon sliding block for carpet loom needs no lubrication. (Photo, Feronyl, Belgium)

Gear for use in anchor winch is machined from centrifugally cast nylon pipe of heavy section. Weight of finished gear is approximately 7 pounds



Injection molded nylon helmets. (Photo, J. Cerfontaine, Belgium)



Soap dispenser is made from four injection molded nylon parts. (Photo, Svenska Metallverken)

quickly during molding, making void-free parts difficult. Nylon-6 with a wider plasticating range and a lower molding temperature than nylon-6/6 is said to be more adaptable to the production of parts with large surface area and thick cross section.

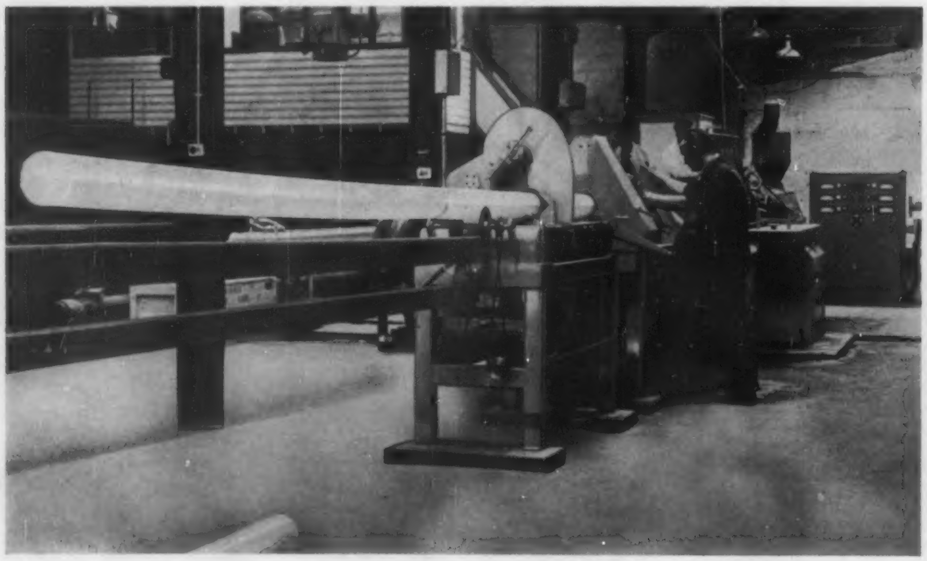
An example of just such a part with a large surface area is an oil carrying can which is presently undergoing extensive tests by two European armies (see p. 132). This can, measuring 4½ by 12 by 15¾ in., and having a volume of 0.40 cu. ft., is molded from nylon-6 as a replacement for a steel can treated internally to prevent corrosion. Even with a coating, the steel can could not guarantee long-term use. Moreover, nylon provides light weight, high impact strength, excellent corrosion resistance, and a wide variety of colors. The price of a nylon can is competitive to metal cans if molded in reasonable volumes. This can is to be used in transporting gasoline, kerosene, and other fuels. It could, of course, also be used for water, oil, alkalies, and a variety of solvents.

Extrusion

Until now rod making and wire coating have accounted for the largest volume of nylon-6/6 being extruded in the U. S. Nylon-6 should fit particularly well into this field and probably broaden the base.

The coating of wire has received appreciable

Complete set-up for extrusion of large-diameter nylon pipe. Pipe has O.D. of about 5½ in., ¼-in. wall thickness. Note absence of end plug. (Photo, R. E. DuPont, England)



Vacuum formed nylon sardine can has 50-mil walls, is sealed with conventional heat-sealing equipment. (Photo, Algemene Kunstzijde Unie)

Tubing of extruded nylon for automotive use; O.D. is about ⅛ in., I.D. about $\frac{1}{16}$ inch. (Photo, Spencer Chem.)

attention through its use in military assault wire on the exterior of cables to provide high strength and abrasion resistance in thin sections. This coating allows wire to be dropped from aircraft or dragged along the ground without damage. Electrical wire coating has been used in the past largely to take advantage of the abrasion resistance and high strength of a thin nylon coating over polyethylene, vinyl, or rubber. Recently nylon has been used in a number of commercial types of vinyl wire to provide a gasoline and oil resistant coating that prevents extraction of the plasticizer from the vinyl by oils, gasoline, and greases. A definite trend appears toward greater consumption of nylon in both industrial and military applications. One of the greatest drawbacks preventing faster acceptance is that the weathering characteristics of nylon are not outstanding in very thin section. However, nylon provides excellent weathering characteristics when compared to polyethylene, vinyl, and other thermoplastics in sections of the same thickness.

Mechanical cable is nylon-coated to increase abrasion resistance and flex life. This is extremely important in the aviation, automotive, and shipping industries, and for use in elevators, cranes, and a large number of similar applications. Flex life of mechanical wire may be increased from four to six times with a coating of nylon-6/10 and eight to twelve times using nylon-6, according to data assembled in Spencer Laboratories.

Pipe and tubing

Reasonable quantities of nylon-6 tubing have been made in the past for uses that could capitalize on its inert chemical properties, temperature stability, and strength. Long standing interest has been evident in the (*To page* 250)

Table III: United States consumption of nylon molding powder by industry[a]
(In thousands of pounds)

	1950	*1951*	*1952*	*1953*	*1954*	*1955*
Automotive	350	940	1,670	252	3,380	3,940
Electrical	90	220	350	550	750	730
Gears, bearings, and bushings	1,050	1,800	3,380	4,950	6,300	6,600
Medical	430	400	700	980	1,000	1,500
Textile	90	220	350	550	620	2,100
Other	90	220	350	550	750	730
Total	2,100	3,800	6,800	10,100	12,800	15,600

[a]The figures exclude resin used for wire coating in the Korean War as this use is not a part of the stable growth market, but represents only a temporary demand.

Portable vinyl beach umbrella

A streamlined version of a beach umbrella—rectangular instead of round—takes advantage of the outstanding physical properties of vinyl film to offer a number of improvements over the conventional fabric type. Weighing less than 2 lb., and folding compactly into a 3 ft. long package, the portable vinyl umbrella can easily be carried to or from the beach or patio—a decided advantage over the clumsier, heavier fabric models. When set up, the tough film not only provides shade, but effectively blocks off winds from the bather. In addition to durability, the vinyl covering is also stain resistant and easy to clean. In case of damage, however, replacement covers, in bright red, yellow, green, or blue colors, are available that can easily be attached to the strong steel wire supporting frame.

Credits: "Sunbrella" manufactured by Hunter Associates, Inc., Beverly Hills, Calif. Velon vinyl supplied by Firestone Plastics Co., Pottstown, Pa.

PLASTICS

Transparent rain bonnet

A sparkling clear polyester film bonnet which is thin enough to be folded down to the approximate size of a silver dollar, yet is tough enough to resist tearing and snagging, lends a glamorous touch to the job of protecting Milady's hats and hairdos from wind or rain. When folded, the bonnet can be inserted into a conveniently small vinyl case (photo, far right); the bonnet unfolds to a substantial 19 by 24 in. size. After each use, a quick pull on the bonnet, holding the eyelets on each end, snaps it into a single pleated strand—ready for refolding.

The bonnet is also recommended as protection for the hair while showering or even when painting. Since the polyester film is unaffected by most oils and chemicals, paint can be removed from the bonnet without damage by using standard solvents.

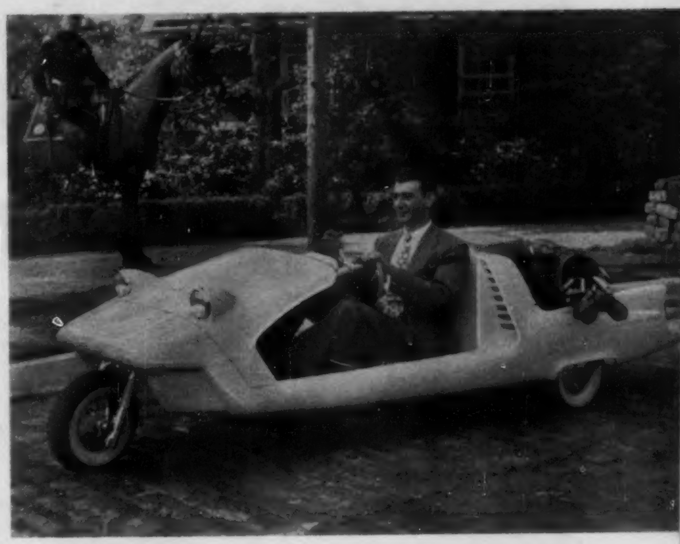
Credits: Rain bonnet manufactured by Eastern Seaboard Plastics, Inc., Newark, N. J. Mylar polyester film supplied by E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.

Three-wheel car has reinforced plastics body

Conceived as a low-cost, highly maneuverable 3-wheel utility car ideal for short haul delivery, the "Star" has the newest version of reinforced plastics automobile body construction. Molded in only two parts that are easily joined together, the body design helps lower the cost of the car to the $1000 level. The Star, which can seat two with comfort, stands less than 3 ft. high, about 4 ft. in width, and 10 ft., 5 in., in length. It weighs 400 lb. and gets 80 miles per gallon.

The Star is recommended for any short haul job, from intra-plant transportation to use as a golf buggy. Because of the low tooling costs involved, the body can be economically made in special shapes for advertising purposes.

Credits: "Star" is manufactured by Bassons Industries Corp., New York, N. Y.; polyester resin supplied by American Cyanamid Co.; fibrous glass cloth supplied by United Merchants Industrial Fabrics, Div., Davis Mills Corp.



PRODUCTS

fabricated of polyester film

Thin-wall, epoxy-glass tubing

Epoxy resin reinforced with woven glass sleeving permits making small-diameter, thin-walled tubing of high strength in long lengths

By Warren E. Ponemon†

For many years the makers of airplanes have been trying to reduce the weight of plane components without sacrificing strength and other important properties. Plastics have played an important part in this program, and it was natural therefore for the manufacturers to eventually turn towards plastics materials in the design of tank probes for fuel gages (Fig. 1). (A B-52 bomber needs 30 of these probes.) Phenolic was the first plastic to be used and soon phenolic tubes had replaced the aluminum ones. But as military airplanes were made bigger and had to fly higher and farther on closer fuel margins, the requirements grew more stringent and characteristics not found in phenolic tubes were called for. These included lower water absorption, higher strength, and greater endurance under shock and vibration. Also, the tube material had to withstand the higher temperatures needed to bake on the new primer coatings used for superior printed circuitry, and phenolics required expensive techniques if they were to yield usable fuel gages. (The gages operate on a capacitance princi-

*Reg. U.S. Pat. Off.
†President, Lamtex Industries, Inc., Westbury, L. I., N. Y.

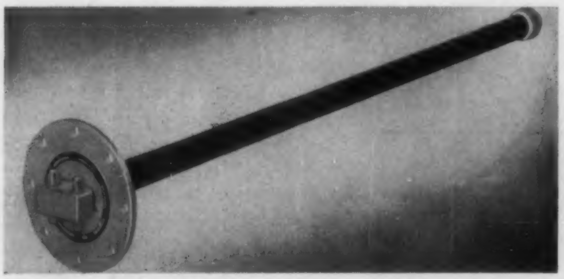


Fig. 1: Probe for aircraft fuel tank, made by Minneapolis-Honeywell Regulator Co. (Photos, Shell Chemical Corp.)

Fig. 2: Epoxy-impregnated glass sleeving, on a mandrel, is hung in an electrically heated oven to cure. Time and temperature of curing cycle are automatically controlled

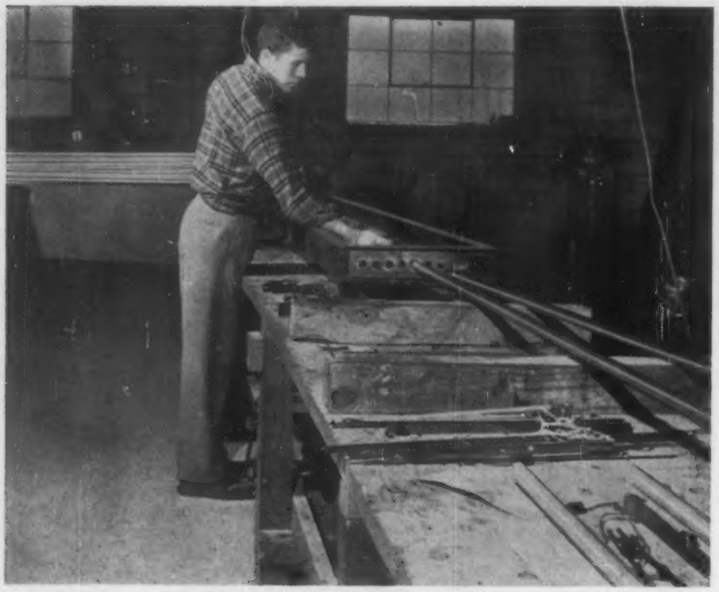


Fig. 3: Cured epoxy-glass tubing is stripped off mandrels

Fig. 4: Tubing end, which had been tied to insure snug fit of impregnated sleeving against mandrel, is trimmed off. All tubing is inspected for dry spots or air pockets, then ground and cut to dimensions

Table I: Chemical resistance of typical "Tuff-Tube" (½-in. O.D., 0.025-in. wall thickness)

Solution	*Weight increase or decrease after 30 days immersion*
	%
Sulfuric acid, 70%	0.20
Sodium hydroxide, 50%	—0.23
Copper plating solution	—0.04
Ethylene glycol	—0.03
Hydraulic brake fluid	—0.18
Aircraft jet fuel	0.08
Distilled water	0.21

ple and are sensitive to minor defects. It is desirable to make the gages to such close tolerances that they need not be individually calibrated.)

The first improvement in the design of the tubes was a substitution of epoxy resin and glass cloth for phenolic and paper. Strengths were improved and water absorption noticeably reduced, but the tubes still had one major drawback: they could not be produced in lengths longer than 4 feet. Longer lengths had to be spliced together in an awkward and expensive procedure.

Why the 4-ft. limitation on length? In standard production, fibrous glass sheet impregnated with epoxy resin is wound around a mandrel until the desired wall thickness has been achieved. The wrapped tubes are then cured and stripped off the mandrel.

During this winding process the mandrel is supported at its ends in a lathe-like machine, and a fair pull is exerted on the sheet so that it wraps tightly. This causes the mandrel to bend, and, since the degree of bending is inversely proportional to the fourth power of its diameter, it becomes progressively more difficult to make a straight tube as the diameter grows smaller and the length longer. For a 4-ft. length, the smallest practical I.D. is ⅜ inch. The process has another inherent limitation that is undesirable in fuel-gage probes: Because the sheet has definite thickness and must begin and end somewhere, the finished tube surfaces, inside and out, are not perfectly circular and concentric. No subsequent grinding operation can correct this defect in form, and an eccentricity of only 5 mils is too much for the present performance objectives for aircraft fuel-gage probes. A third limitation of the wound-sheet process is that great care must be exercised to prevent dry spots, porosity, and seam lines, which make coating difficult and which aggravate fuel drainage and humidity problems.

New process uses new materials

The big question was how to produce fibrous glass reinforced epoxy tubing, possessing the same

properties as the rolled type, but without its shortcomings. After much experimentation with various materials, we found our answer in glass sleeving, Epon[1] resin 828 and metaphenylene diamine curing agent.

Using continuous-weave glass sleeving has an obvious advantage. Because sleeving comes in a roll, our only limitation in tubing length is the mandrel we can hang in our curing oven. We now produce tubing up to 9 ft. long, and are tooling up for a limited production of 15-ft. long tube.

The new resin-curing agent combination has better wetting ability than any other combination we tried, thus resulting in a denser, more homogeneous, stronger laminate, free of air pockets or dry spots. In addition, the new technique offers the following benefits:

1) *Smaller inside diameters are possible.* No rolling is involved in the new method, so that mandrels of any diameter may be used. The smallest tubing we have produced has an I.D. of 1/16 inch.

2) *Wall thicknesses are uniform and may literally be "paper-thin."* The epoxy-impregnated glass sleeving has, of course, no overlap or inherent eccentricity of any sort, so that its O.D. may be ground down as much as desired without fear of breaking through. Some of the tubing we have produced has been ground to a specified wall thickness of 8 mils, which is about 3 times the thickness of the page you are now reading. Eccentricity can easily be kept to ± 2 mils with conventional centerless grinding, and closer tolerances can be held using special techniques.

3) *The glass-epoxy combination is very strong.* It is well known that glass-reinforced epoxy resins have high impact strength, high endurance limit, and excellent mechanical properties. The epoxy tubing is far superior to phenolic tubing in such properties, and will meet the following requirements, described in specification MIL-G-7818: resistance to vibration, humidity, and thermal shock; operation between −96 to 158° F.; fungus resistance; and salt spray test. The new tubing, known as Tuff-Tube, also holds its strength well during prolonged exposure to high temperatures. For example, its tensile strength (at room temperature) is 41,000 p.s.i.; after 300 hrs. at 400° F. it decreases to 32,000 p.s.i., still a very respectable figure. Modulus of elasticity does not suffer at all in this test.

4) *Electrical properties of the epoxy-based tubing are excellent.* Epon resin 828, the principal ingredient of the tubing, when cured with metaphenylene diamine, has an insulation resistance

[1]Shell Chemical Corp.

Table II: Mechanical and electrical properties of typical "Tuff-Tube" (½-in. O.D., 0.025-in. wall thickness)

Dielectric strength	500 v./mil
Volume resistivity	1×10^{16} ohm-cm. at 77° F. 1×10^{10} ohm-cm. after 96 hr. immersion in water @ 158° F.
Operating temperature	Up to 450° F.
Dielectric constant	5.1
Compressive strength, axial	27,600 p.s.i. After immersion in water @ 158° F. for 96 hr. 24,500 p.s.i.
Modulus of elasticity	2.8×10^6 p.s.i.
Dimensional stability	Expansion less than 0.0007 in./in. after 96 hr. immersion in water at 158° F.

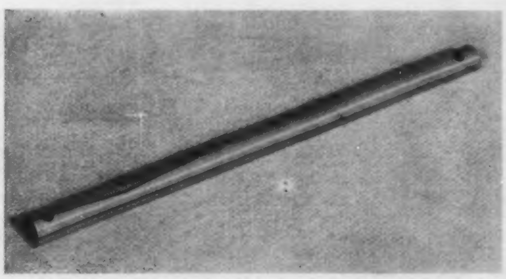


Fig. 5: Fuel-probe component made of epoxy-glass tubing. Tube has been metallized with silver paste that coats entire tube except dark areas. Proper design of this coating permits exact measurements of fuel weight, regardless of shape and position of tank

Fig. 6: Various shapes and wall thicknesses of epoxy-glass tubing. (Photos, Shell Chem. Corp.)

of 10^{16} ohm-cm at 77° F. and 10^{12} ohm-cm at 302° F. Additional electrical characteristics are listed in Tables II, p. 141, and III, below.

5) *Water absorption has been practically eliminated.* After 15 cycles of the humidity test described in MIL-G-7818, the water absorption was 0.5%, compared to 6.8% for phenolic tubing.

6) *Chemical resistance, particularly to jet fuels, is excellent.* Table I, p. 140, shows the chemical resistance of the epoxy tubing to a variety of reagents.

7) *The new type of tubing has a higher strength-weight ratio than aluminum.* A conventional aluminum fuel-gage probe weighs 0.030 to 0.045 lb. per in. of length. Units using the reinforced epoxy tubing range in weight from 0.010 to 0.020 lb. inch. The major reason for the weight saving is the higher strength of the laminate.

Production of the tubing is quite simple. Glass sleeving, pretreated with Volan A, is slipped over a suitable mandrel, which has previously been covered with a parting agent. The glass sleeving is impregnated with resin and curing agent. The resin is then cured and post-cured in an electrically-heated, forced-draft oven (Fig. 2, p. 139). After that, we strip the tubing from the mandrel, trim the ends, grind the O.D., inspect to specification, cut to size, and ship (See Figs. 3 and 4, p. 140). A finished tube, already metallized, is shown in Fig. 5.

Table III: Typical electrical properties of Epon-828 glass cloth laminates[a]

Dielectric constant		
Frequency, cycles	*75° F.*	*212° F.*
60	5.50	6.10
10^2	5.49	
10^3	5.42	
10^4	5.33	
10^5	5.18	
10^6	5.05	
1.5×10^7	4.89	
7.8×10^7	4.81	
Dielectric strength, v./mil		
(ASTM D 149-44)		
Short time	410	
Step-by-step	310	
Dissipation factor		
Frequency, cycles	*75° F.*	*212° F.*
60	0.006	0.004
10^2	0.0096	0.0139
10^3	0.0089	0.0084
10^4	0.0135	0.0061
10^5	0.0173	0.0072
1.5×10^7	0.0204	
7.8×10^7	0.0197	
Arc resistance at 75° F., and 50% R.H., sec.		
(ASTM D-495-48T)	127	
Insulation resistance, megohm		
Initial, room temperature		20×10^6
After 24 hr. at 35° F. and 90% R.H.		5×10^6
Initial, at 140° F. and 95% R.H.		1×10^6
Volume resistivity, ohm-cm.		
Initial, room temperature		1923×10^{12}
After 24 hr. at 35° F. and 90% R.H.		2000×10^{12}
Surface resistivity, ohm-cm.		
Initial, room temperature		238×10^{12}
After 24 hr. at 35° F. and 90% R.H.		240×10^{12}

[a] Laminates were prepared using Epon 828, 181 glass cloth with a Volan A finish, and 15 phr (parts per 100 parts of resin) of metaphenylene diamine. Dry lay-up was used, the laminates containing 34% (by weight) of cured resin. Cure cycle was 30 min. at 290° F. and 200 p.s.i., with a postcure of 1 hr. at 400° F.

Applications

Although the production of this special tubing was originally prompted by the needs of the aviation industry—fuel tank probes are still the largest single application—other worth-while uses have since been found in the electrical industry. In one instance, epoxy tubing with a wall thickness of only 10 mils replaced paper-based phenolic condenser jackets, having a wall thickness of 23 mils. Because this particular condenser had to be fitted between the wall of the chassis and other components, a very thin jacket was required, yet the jacket had to possess suficient insulation resistance to keep the condenser from shorting out.

The electrical industry is also using *square* epoxy-glass reinforced tubing, some of which is shown in Fig. 6, for coil forms. These coil forms had generally been wound from paper-base phenolic, which was not too satisfactory because the forms often did not have perfectly square inside corners. Thus, they were hard to mount on the coil winding machines, and later, equally difficult to insert over the transformer iron. As an alternate, silicone-impregnated mica paper was tried. However, mica forms are about twice as expensive as epoxy forms, and they have a tendency to delaminate. In addition, the epoxy forms can be made available in longer lengths (up to 8 feet). This permits the user to wind a large number of coils at one time.

Some circular tubing is also being used as electrical conduit and as rectifier insulating tubes. Tubes have been made with a narrow rectangular cross-section to serve in wave guides. Almost any polygonal section is possible.

Preplasticators pay off on small shots, too!

*By Harold H. Schwartz**

Preplasticators[1] have repeatedly made news by making possible the injection molding of very large articles, and machines are now available with shot capacities as high as 25 pounds. But preplasticators offer many advantages for making smaller shots, too. These advantages add up to higher productivity of machines and personnel, and improved quality in moldings. They also make it possible to do certain small-shot molding jobs that could not practically be done without them.

In the early days of Empire's Plastics Division, we, like most molders, were using standard machines (in our case, horizontal Impcos with vertical clamping). Later, when some of the larger shots were taxing the shot capacities of our machines, we installed a preplasticator on one of them. Operators began turning out better-quality pieces at substantially higher rates than we had been getting from many of our molds.

Higher output

The speed of molding cycles may be limited by a number of conditions. Most frequently it is limited either by the plasticating capacity of the machine, the time required to cool the molding to self-supporting stiffness, or, especially with older machines, the time it takes the machine to go through its motions. When inserts must be placed in the mold and the finished pieces removed by hand, the "mold-open" time may be a substantial part of the total cycle time. The preplasticator can reduce all but the mold-open time.

In standard machines it is customary to shoot about 60% of the cylinder's rated shot capacity. With a preplasticator, it is feasible to shoot a much smaller fraction of the nominal shot capacity. For example, we make 16- and 18-oz. shots in machines rated for 52 oz. and more. This large reserve of plasticating capacity may at first glance seem wasteful, but it actually pays. It guarantees that the cycle will not be limited by the plasticating rate. While it is true that the plastic is kept hot much longer, this is easily compensated by the fact that, with the much larger cylinder areas, the heat can be put in at much lower wall temperatures. Thus none of the plastic need be heated to temperatures at which the rates of degradation reactions are high. A small amount of badly degraded material, such as is likely to be formed in the very hot layers next to the walls of standard cylinders, can severely reduce the physical properties and, at the same time, mar the appearance of the molded articles.

This reduction of temperature at the walls, together with the mixing action that occurs as the preplasticated melt is squirted from the preplasticating chamber into the injection cylinder, can actually provide a higher *average* melt temperature with a much lower top melt temperature than can a standard cylinder alone. This is an advantage when very fast filling is wanted. Conversely, a lower average melt temperature can be maintained without fear of injecting unmelted particles into the mold. Where the cycle is limited by the setting time, this ability to get a very uniform melt temperature a few degrees above the molten point[2] makes possible good pieces on shorter cycles.

In standard machines we were sometimes troubled with short shots because of insufficient plasticating capacity and melt fluidity. It was more economical to block off one or two cavities in a multicavity mold then to lengthen the cycle sufficiently to fill all of them. The preplasticator put an end to this problem.

Preplasticators also reduce cycle time in another way when fraction-of-capacity shots are being molded.

The ram travel that is required to empty only a small part of the cylinder is very little. Furthermore, there is nothing but melt in the injection cylinder, so injection begins as soon as the ram starts to move. The dead time typical of standard operation is eliminated and the actual injection time is cut, too. This is true even when injection time is controlled by the resistance to melt flow of the runners and gates because the pressure on the melt is easily made higher in a preplasticating machine than in a standard machine, where a large fraction of the ram pressure is dissi-

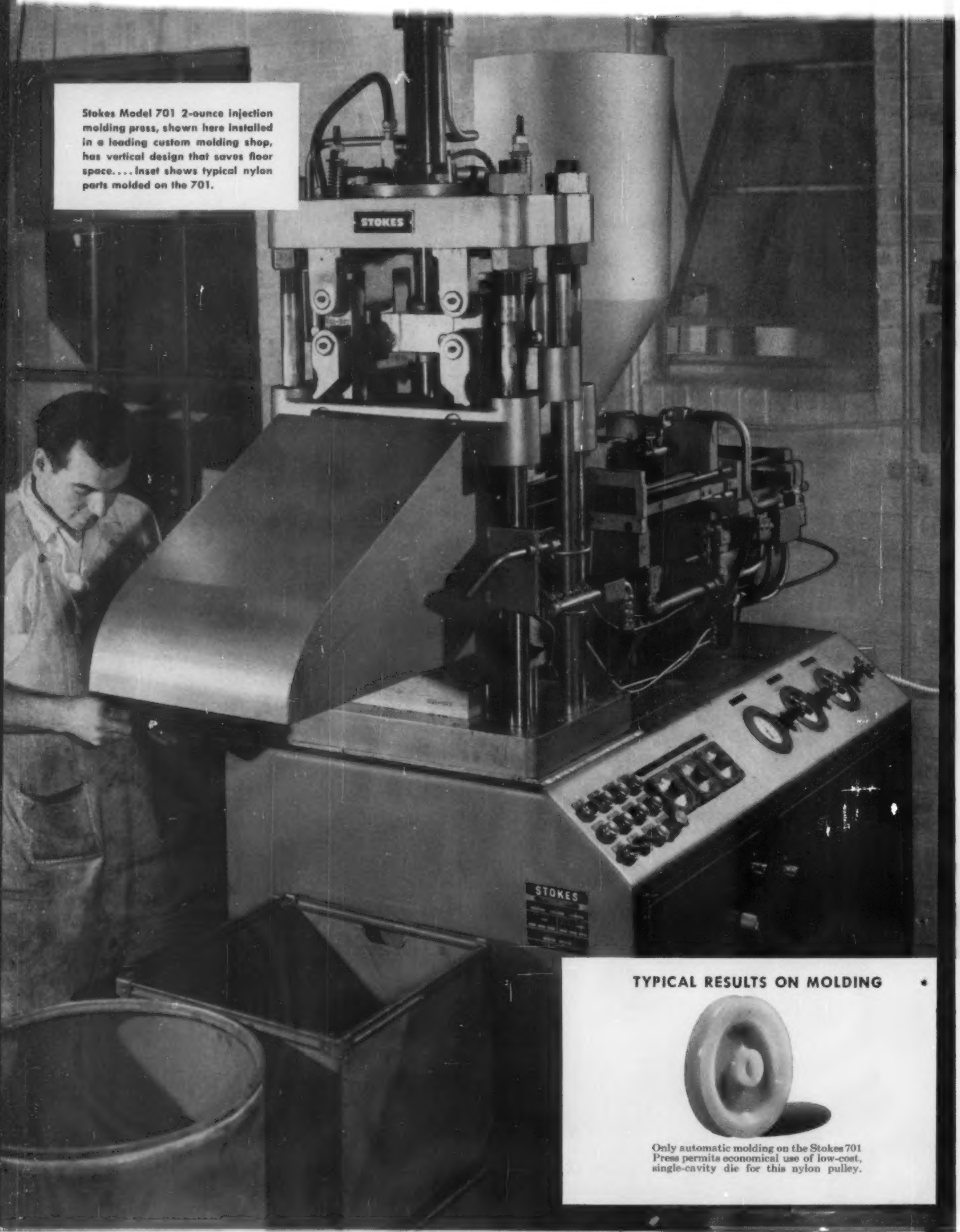
(*To page* 146)

*General Manager, Empire Brushes, Inc., Port Chester, N. Y.

[1] This term is used in place of the conventional "preplasticizers" to gain precision. The verb plasticize means to soften by adding a low-molecular-weight liquid. Plasticate means to soften by heating, either through direct transfer of heat or by viscous working. Thus, "preplasticators."

[2] The term "molten point" is introduced here because the term "melting point" is not really applicable to polymers, which begin melting at temperatures that are 20° C. or more below those at which they are just completely melted. The "molten point" refers to the upper limit of the melting range.

any polygonal section is possible.



Automatic molding of nylon is easy . . . and economical . . . on the new Stokes Model 701 Press

New Stokes truly automatic 2-ounce injection molding press incorporates advanced design features that eliminate "drooling," improve uniformity, save material, produce high output at low cost.

If you're molding—or planning to mold—nylon parts, the new Stokes Model 701 is the press you've been looking for. Built into it are features, based on Stokes pioneering experience in automatic molding, which are useful in any injection molding operation . . . and especially valuable when you're molding nylon.

"Drooling" eliminated. The positive nozzle shut-off developed by Stokes prevents the usual troublesome stringing of nylon.

Fast, uniform heating. Positive shut-off at the nozzle permits full-pressure prepacking of the injection cylinder. Materials such as nylon which are difficult to heat and plasticize are heated faster and more uniformly, because heat conductivity gets higher under pressure. Every shot is uniformly plasticized . . . critical temperatures are accurately maintained.

Close tolerances—low mold cost. The 701 press operates on so fast a cycle—only 3½ seconds between mold opening and start of next fill—that only a few cavities are needed to get high output. The simpler molds cost less . . . and there is less variation in dimensions of parts produced.

Automatic separation of runners and parts. No manual sorting or de-gating is required. Runners can be immediately ground and re-used.

Low labor cost. The 701 requires only about *one-tenth* of a man's time. It molds, de-gates, ejects, and sorts automatically.

Applicable to every injection molding job, the Model 701 proves economical on short or long production runs, and on simple or close-tolerance parts. It is exceptionally easy to set up and to maintain. For complete facts, write for a copy of our latest bulletin. And ask for a consultation by the Stokes Advisory Service to estimate the cost savings that can be realized on your specific parts.

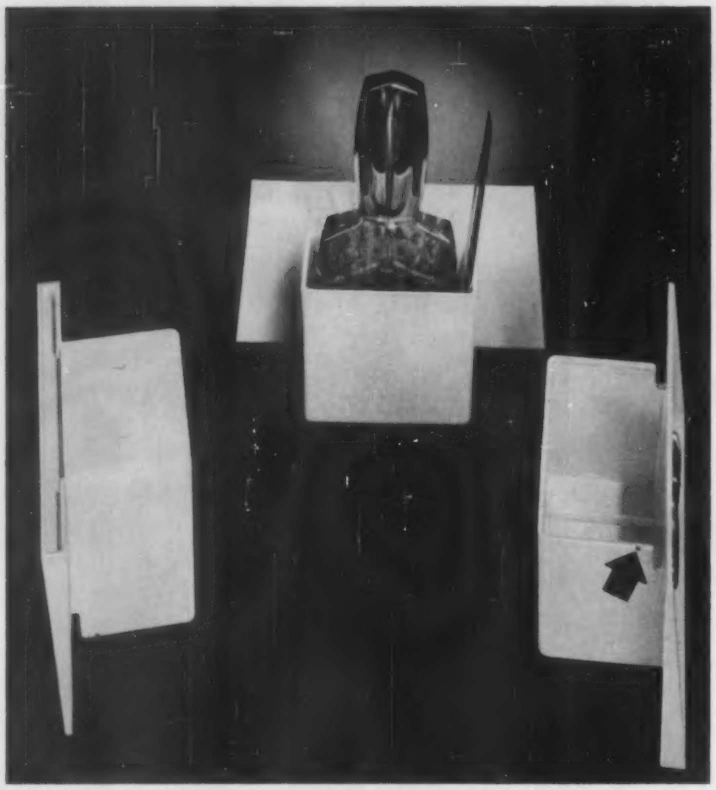
NYLON PARTS WITH THE STOKES MODEL 701 PRESS

Uniform, automatic cycling of the Model 701, and economical output with few cavities, allow close tolerance molding of this nylon roller.

Automatic de-gating and low tooling charges on the Stokes Model 701 make it possible for this mop handle coupling to be made of nylon at a cost competitive with a metal part.

Plastics Equipment Division
F. J. STOKES CORPORATION
5531 Tabor Road, Philadelphia 20, Pa.

STOKES



Use of a preplasticator makes it feasible to mold thin-walled items such as these comb-and-brush containers. Dark speck on sample at right (arrow) is the gate—which has been marked with ink for better visibility in the photo. The decoration which can be barely seen along the right of the sample (actually its front) is molded separately of red polystyrene and cemented on. Note the deep recess molded into bottom of upside-down container at left

pated in the packing zone at the rear of the cylinder.

Still another way in which the preplasticator helped to increase productivity was this: We found that with it our down time during production runs was reduced from about 8 to 10% to about 3 to 4 percent.

Some figures from our production records will show how much preplasticators can boost output. In one of our molds, a 4-cavity mold in which polystyrene shots weigh about 460 g., or just over 1 lb., the standard net production on machines without preplasticators was 130 units per hour (u.p.h.). With a preplasticator on the same machine we averaged 180 u.p.h., a 38% increase. This higher rate was easily handled by the operator, who also washes and trims the finished shots. On another job, a 517-g. shot, the preplasticator upped the rate from 250 to 324 u.p.h., a 30% gain. Production on a third mold, a 365-g. shot, jumped from 330 to 403 u.p.h.; on a fourth, a big 570-g. shot, output rose from 125 to 180 u.p.h.; on a 620-g. car-wash brush, on which the standard rate was 110 u.p.h., the preplasticator made 154 u.p.h., a 40% increase. These are all net production figures and show the combined increase in rates brought about by all the above causes. On the average, we have realized production rates about one-third higher than we got with standard machines, at no increase in labor cost. Thus we are now making in nine months what we used to make in twelve. Depending on the value of this extra production and the labor costs saved, the preplasticator soon pays for itself.

It would of course be possible to get some of the advantages of the preplasticator by using a much larger standard machine and running it far under its capacity. But that would require a higher investment, more power, and more floor space.

Better quality, too

In molding brush backs it is essential to reduce molded-in stresses to the lowest possible level. Bristles are installed by stapling the bundles into holes drilled into the plastic. Backs with high molded-in stresses frequently crack when the staple is driven. We found that the higher but more uniform melt temperature of the preplasticator and the higher melt pressure available during filling resulted in the cavities being filled much more rapidly.

Molded-in stresses have been reduced to the point where, today, almost no brush backs are cracked during stapling. Since we make and use millions of such backs each year, this improvement in quality also brought us a substantial saving.

Wherever close control of dimensions, and therefore of shrinkage, is needed, the preplasticator is a big help. Shrinkage depends on the equation of state for the plastic[3] and on the melt temperature and pressure in the cavity when the gate seals. Because plastics are compressible, more matter is forced into the mold cavities at higher pressure, and *vice versa*. The final dimensions of the molded article depend directly on the mass of stuff that is sealed into the cavity. Changes in the melt temperature have a similar effect, but in the opposite direction. Thus, anything that can be done to increase the uniformity of melt temperature and pressure will improve control of tolerances.[4] The preplasticator is a device that does just this.

The improvement in control is shown by the data in Table I,

[3]G. D. Gilmore and R. S. Spencer, "Role of pressure, temperature, and time in the injection molding process." Modern Plastics 27, 143 (April 1950); C. E. Beyer and R. B. Dahl, "Basic principles of injection molding." Modern Plastics 30, 103 (March 1953).

[4]These factors must also be kept the same for all the cavities to eliminate inter-cavity differences in piece dimensions. To this end we use identical gates and runners in almost all our molds. See "Runner and gate design." Modern Plastics 34, 166 (Oct. 1956).

p. 148, which give weights of consecutive shots from typical molds being run in very similar machines, one with and one without a preplasticator. The plastic was general-purpose polystyrene in both cases. Both machines had been operating steadily (on timer-controlled cycles) for many hours before these shot weights were measured.

An appropriate statistical measure for use here is the coefficient of variation, which expresses the variation as a percentage of the measured value. For these two sets of data the coefficients of variation are 0.53% with the preplasticator, 2.09% without. These numbers may be interpreted in this way: on the average, of each 100 pieces molded, 95 will have weights ranging between ±1.06% of the average shot weight in the preplasticating machine (or ±4.18% in the standard machine); the other 5 pieces will have weights outside these limits.

This variation in weight reflects an equal variation in volume, since density is constant. In a molding like these brushbacks, where there is no great disparity between the different dimensions, this variation in volume is split about equally in all three principal directions, so that any one dimension will vary about ⅓ as much as the weight. Thus we would have found on measuring the moldings that about 95% of the lengths would fall between ±0.35% of the average for those made in the preplasticator, ±1.39% for those made in the standard machine. Translated into length units these figures correspond to 3.5 mils/in. and 13.9 mils/in., respectively. Five percent of the production would show even wider limits. These figures should not be confused with the shrinkage, which is usually a good bit larger. They do, however, represent the observed variations that would have been found in the final dimensions of the finished pieces.

Neither of these machines was equipped with a weigh-feeder. It is doubtful that a weigh-feeder would reduce the variation of shot weight in the preplasticating machine, but one of the newer backup-sensing feeders might very well improve the performance of the standard machine in this respect.

Does the "impossible" jobs

Large-area, thin sections have always made trouble for molders. One of the biggest troubles is the difficulty filling them. This difficulty is magnified in multicavity molds, where slight differences in runner length, gate dimensions, and local temperatures result in filling some cavities while only partly filling others. Here the preplasticator offers three big advantages: 1) higher safe working melt temperature, with consequent greater melt fluidity; 2) higher melt-moving capacity; and 3) higher available melt pressure. These three advantages add up to faster filling, the secret of success in filling thin sections. These same factors also make it possible to use smaller gates with a preplasticating machine than would be feasible with a standard machine. The reduction in gate size can make a sizeable difference in finishing costs. The photo on p. 146, for example, shows a pair of our "Corral Containers," each designed to hold a brush and comb. These containers have a total surface (one side) of about 32 sq. in. and a wall thickness averaging 80 mils. They are filled through tiny square gates, 25 mils on a side, located at the top and toward the front of the left side face of the box part. (See photo). Near the end of this long flow, at the bottom of the front face, the melt is divided into two streams to make the indented bottom.

These pieces are made in an 8-cavity mold with an "organization-chart" (OC) runner layout.[5] This mold cannot be filled on our standard machines, but with the preplasticating machines we can consistently fill all eight cavities. (It was necessary to vent these cavities well to prevent burning at the high filling rate used.) Molders daily encounter many similar jobs that are profit-killing headaches on standard machines of economical capacity, but that could be molded easily in a preplasticating machine.

Conclusion

To sum up, the preplasticator supplies a melt with a very uniform temperature at almost any desired pressure. It permits versatility in temperature control to accomplish either very rapid filling or very fast setting without the attendant risks, suffered in a standard machine, of degrading the plastic or shooting unmelted material. By injecting from a cylinder filled entirely with melt much better control of injection pressure is obtained, with resulting reduction of variation in piece weights and dimensions. Articles can be molded almost free of frozen-in stresses. Finally, the increased productivity of the preplasticator soon pays for its cost.

Table I: Weights of consecutive shots

Molded in 12-cavity mold in 80-oz. preplasticating machine		*Molded in 8-cavity mold in 22-oz. standard machine*	
Nominal weight = 778 g. (27.5 oz.)		*Nominal weight = 363 g. (12.8 oz.)*	
777.7	777.1	363.3	362.9
777.5	776.6	362.7	362.6
777.7	777.0	363.3	362.1
777.5	778.4	363.0	363.0
777.3	778.0	363.3	362.1
777.8	777.5	362.6	362.6
778.0	777.8	363.1	361.9
777.9	777.3	363.0	362.9
778.2	777.3	363.3	361.8
778.1	777.0	363.1	362.6
777.4	777.2	363.6	362.8
777.2	777.7	363.4	361.5
777.3		362.8	

[5]See ref. 4, p. 146.

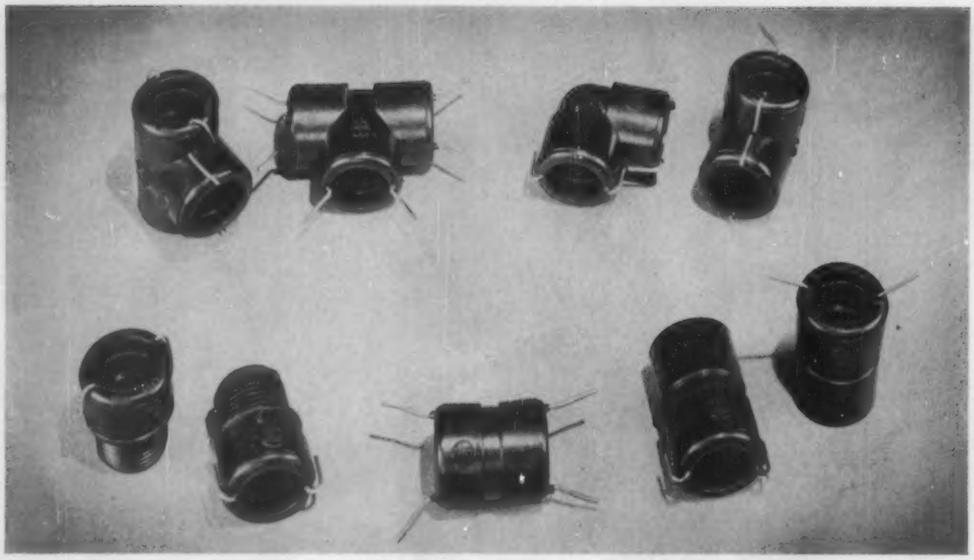


Fig. 1: Assortment of resistor fittings for polyethylene tubing, including tees, elbows, couplings, and threaded fittings to permit joining of polyethylene and metal tubing and pipe. Molded-in ribbon resistors can be seen lying flush with inside surfaces of fittings

Resistance-welded plastic pipe joints

New method for joining thermoplastic pipe uses simple equipment, produces strong, tight joints

The convenience of using thermoplastic pipe and tubing is likely to get a big boost from a newly developed method of making joints. The method depends upon polyethylene fittings[1] that have ribbon resistance elements molded flush with the inside surfaces of the fitting. Several typical fittings for ½-in. I.D. tubing are shown in Fig. 1; Fig. 2 shows a close-up of a coupling that was cut open length-wise to expose the resistance elements.

The method of joining is strikingly simple. The end of the polyethylene tube is cut off squarely and pushed into the fitting (Fig. 3) until it butts against an inner shoulder. The leads from the inside resistors are connected to a 6-v. heavy-duty storage battery through a timing unit (Fig. 4). The timer can be preset to the heat requirements of pipes and tubes of various sizes. It automatically adjusts the welding time to compensate for variations in the temperature of the plastic and in accumulator potential. When the weld is complete, the leads are snipped off (Fig. 5).

These joints have all the usual attributes of polyethylene, including its remarkable resistance to corrosive chemicals. The Nichrome heating elements are completely sealed in when the weld has cooled and are therefore not exposed to whatever fluids the pipe might carry. The high coefficient of expansion of polyethylene and the close fit of the tube in the fitting combine to yield a very solid joint. From the standpoint of strength the weld is made in the best place and encompasses most of the area of contact between tube and fitting.

In Great Britain, where these joints were first introduced, they have stood up well to flex and fatigue testing and have performed well in high-vacuum systems.

[1] Manufactured by the St. George Light Engineering Co., Letcombe Regis, Wantage, Berkshire, England.

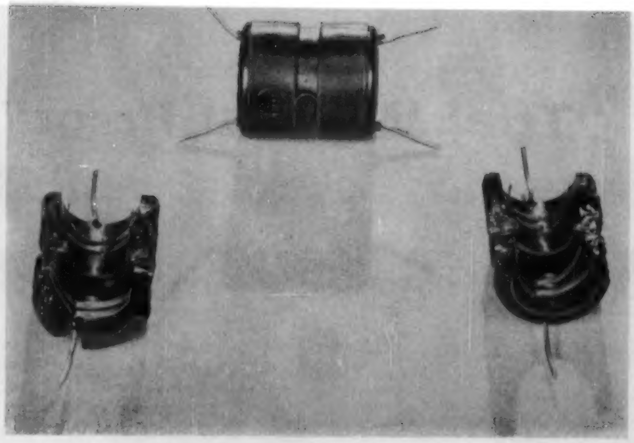


Fig. 2: Two couplings, one split lengthwise to reveal details of structure. Preformed resistor ribbons are welded to heavy, low-resistance lead wires and molded into final position

Fig. 3 (below): Making a welded T-joint with a resistor fitting. First, the square-cut end of polyethylene tube is inserted in the fitting

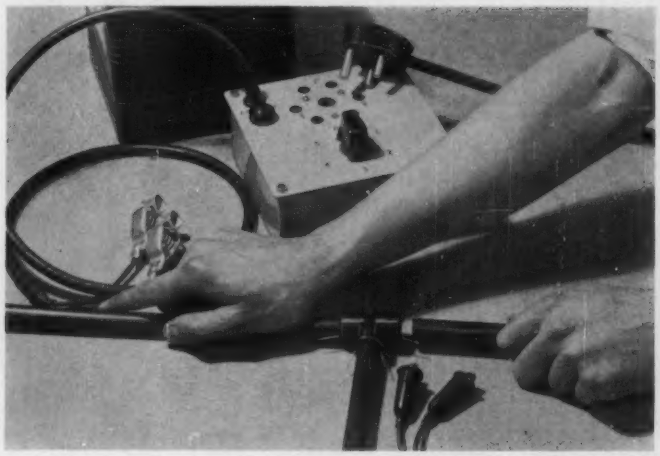


Fig. 4 (right): Next step is to clip connecting wires onto resistor leads. In this size, resistance of heating elements is roughly 0.06 ohm. Connector is plugged into correct timer sockets, depending on size of tubing

The fittings are made in a range of sizes. They can be installed anywhere, even close to walls and in tight corners, because no manipulation of the tube and fitting is required and no flames are used. The method is so simple, requiring almost no skill, that anyone can make good joints with them. Work that is now in progress may eventually lead to even further simplification of the equipment.

The method is not limited to polyethylene, although that is at present the only material in which the resistor fittings are being stocked. It works just as well with other thermoplastics.

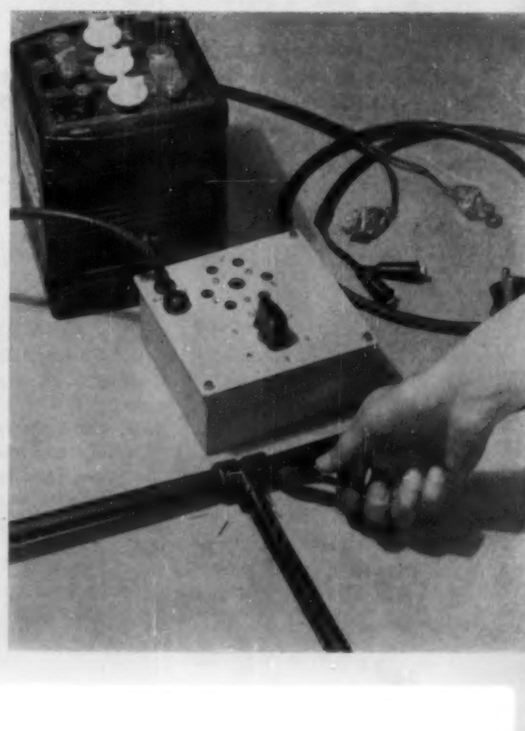


Fig. 5: Final step, after timer has shut off current and weld cools, is to snip off the lead wires. Once welded, these joints can be reheated to slip them apart; however, the inside surfaces of the fittings are distorted to a degree that would interfere with rewelding. (Photos 3, 4, and 5, St. George Light Engineering Co.)

Dr. Gordon M. Kline, Technical Editor

Accelerating effect of amines

on polymerization of methyl methacrylate

By G. M. Brauer,† Ruth M. Davenport,† and William C. Hansen†

A modified ultrasonic viscometer was used to follow the course of the polymerization of methyl methacrylate at 37° C. in the presence of the most efficient benzoyl peroxide-amine systems. The reaction proceeds fastest in the presence of tertiary aromatic amines. The rate of polymerization often is different from what one would expect from the relative rates of the amine-accelerated peroxide decomposition in non-polymerizable solvents. With many amine-peroxide systems, the polymerization reaction does not go to completion.

The relative order of efficiency of amines in the polymerization of monomer-polymer slurries is not always the same as that found in the polymerization of monomer. Polymerization with N,N-dimethyl-p-toluidine or 2,2′-(m-tolylimino)diethanol gave products having the best physical properties. Improvement of some physical properties, such as indentation and recovery, is obtained on decreasing the setting time. With effective amine accelerators, colored products are formed.

Tertiary amines have been used for a number of years as accelerators for the peroxide-catalyzed polymerization of methyl methacrylate. These accelerators make possible the rapid polymerization of monomer or monomer-polymer slurries at room temperature (1-8).[1] Such mixtures have found considerable usefulness in dental filling resins, cements, and denture base materials.

The increase in the polymerization rate is caused by the more rapid decomposition of peroxides in the presence of the amines. The kinetics of the decomposition of solutions of benzoyl peroxide with a number of amines were studied by Bartlett and Nozaki (9) and Meltzer and Tobolsky (10). The latter showed that dimethylaniline in the benzoyl peroxide-dimethylaniline-initiated systems does not affect the propagation or termination steps of the chain reaction. It must therefore change the initiation step.

Horner and co-workers (11-18) proposed the mechanism shown in Fig. 1, p. 154. Presumably during the bimolecular reaction between the amine and the benzoyl peroxide, a transition state (A) occurs in which a transfer of an electron from the unshared pair of the nitrogen to the peroxide takes place. The benzoylate anion removes a proton from the aminium cation, either in the α position of the side chain (C) or from the aromatic nucleus, preferably from the para position (C′). On transfer of an electron from the carbon to the nitrogen, free radicals are formed (D and D′), which may undergo 1) oxidative dealkylation, 2) substitution, 3) reaction with solvent or oxygen, or 4) act as polymerization initiators in the presence of vinyl compounds.

Identification of benzoic acid, carbon dioxide, formaldehyde, N-methylaniline (E), p-benzoxy-N,N-dimethylaniline (F), p,p′-tetramethyldiaminodiphenylmethane and chloride ion from reaction mixtures of benzoyl peroxide and dimethylaniline in chloroform (17) support this mechanism. When the reaction

[1]Numbers in parentheses link to references at end of article, p. 256.

*Reg. U.S. Pat. Off.

This work is a part of the dental research program conducted at the National Bureau of Standards in cooperation with the Council on Dental Research of the American Dental Association, the Army Dental Corps, the Air Force Dental Service, the Navy Dental Corps and the Veterans Administration. It was in part presented at the 32nd meeting of the International Association for Dental Research, French Lick, Ind., March 1954.

† National Bureau of Standards. The authors wish to thank Mr. Francis R. Burns for assisting in the experimental work and the various firms that supplied materials for use in this investigation.

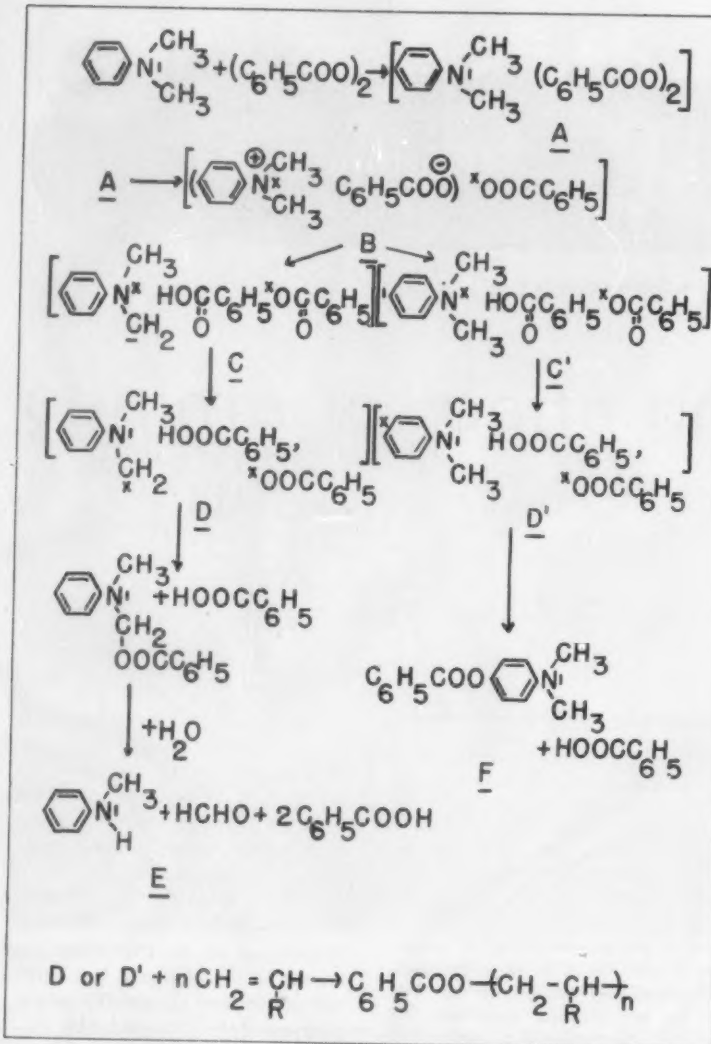


Fig. 1: Proposed mechanism for the dimethylaniline-activated decomposition of benzoyl peroxide

occurs in air, oxygen is absorbed and secondary peroxides are formed which decompose with the formation of hydrogen peroxide and N-methylaniline. This can be explained by the mechanism shown in Fig. 2, below.

Goode and Gratsch (19) established that one mole of amine is required for the decomposition of one mole of peroxide in benzene. A large portion of the amine may be removed unchanged, while small amounts of the amine are converted into formaldehyde, N-methylaniline, and *p*-benzoxy-N,N-dimethylaniline. The decomposed peroxide can be accounted for nearly quantitatively as benzoic acid.

Imoto and Choe (20) assume that the reaction of benzoyl peroxide with dimethylaniline starts with the formation of an intermediate complex produced by coordination of the unshared electron pair of the nitrogen atom in the dimethylaniline with the central -O-O- atoms in the peroxide molecule, as shown in Fig. 3, p. 156. This unstable intermediate decomposes into *o,o'*-dimethylaminodiphenyl, *p*-dimethylaminophenyl benzoate, and benzoic acid. The ease with which the formation of the intermediate can be attained determines the decomposition rate of the benzoyl peroxide. When an electron-attracting group is introduced into

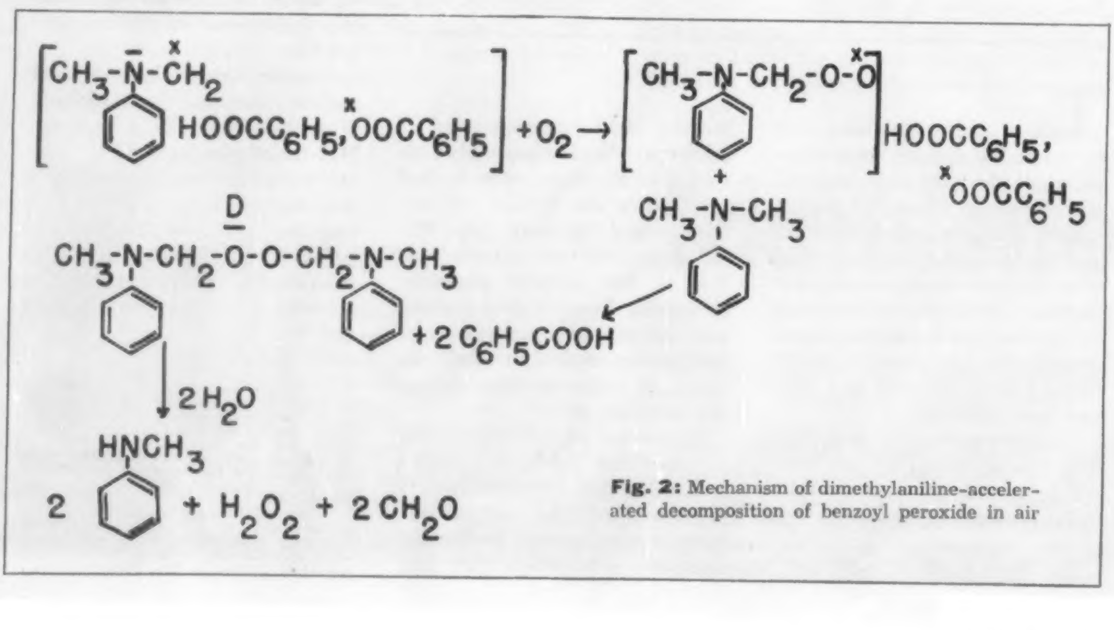


Fig. 2: Mechanism of dimethylaniline-accelerated decomposition of benzoyl peroxide in air

the benzoyl peroxide molecu-

Table I: Polymerization of methyl methacrylate in the presence

extremely large variations of the

the benzoyl peroxide molecule, the polarization of the carbonyl group decreases and the positive charge on the central oxygen atoms becomes larger. Formation of the intermediate coordination compound from dimethylaniline can take place more readily and the rate of decomposition of benzoyl peroxide is speeded up.

Some data on the relative efficiency of amines as accelerators in the benzoyl peroxide-initiated polymerization of methyl methacrylate have been reported (21). Since the completion of this investigation, Lal and Green (22) have reported a qualitative study of the activating effect of a number of amines on the rate of polymerization. They recorded the peak temperatures and peak times for the polymerization of methyl methacrylate slurries.

The results of a qualitative investigation of the polymerization of monomer and a number of monomer-polymer slurries in the presence of various amines are given in this report. The rate of polymerization was followed by means of an ultrasonic viscosity apparatus.

Materials

The methyl methacrylate monomer (Rohm and Haas) was inhibited with 0.006% hydroquinone.

The benzoyl peroxide (Eastman) was reagent grade.

Sources of the amines are given in Table I, right. These amines were used without further purification.

The polymer powder (L. D. Caulk Co.) contained 1% by weight of benzoyl peroxide.

Apparatus

The polymerization rate was determined by means of an ultrasonic viscometer (Ultra-Viscoson Model XV) manufactured by Rich-Roth Laboratories (23). The instrument includes an analog-type computer which produces an electrical output that is a function of viscosity and density. The instrument was modified to increase the range of the instrument and to expand the lower scale readings below 1 cp.-g./cm.^{3}, as described in the Appendix, p. 168.

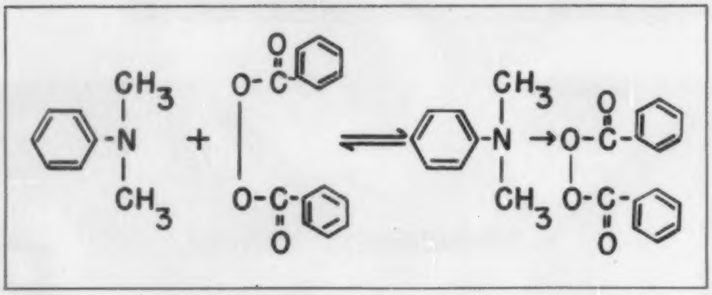


Fig. 3: Formation of benzoyl peroxide-dimethylaniline complex

Table I: Polymerization of methyl methacrylate in the presence of various amines

Benzoyl peroxide concentration 2%
Amine concentration......... 2%

Amines	*Source*[a]	*Setting time* hr.	*Color*
Aromatic amines			
N,N-Dimethylaniline	*E* reagent	< 1	Amber
N,N-Diethylaniline	*F* reagent	< 1	Dark brown
N,N-Di-*n*-propylaniline	*E* reagent	< 2	Amber
2-Anilinoethanol	*E* reagent	np.[b]	——
2-N-Methylanilinoethanol	*E* reagent	np.	——
2,2′-(Phenylimino)diethanol	*TE*	< 1	Gold
2-N-Ethylanilinoethanol	*TE*	> 24	Layered brown-yellow
N-Phenylglycine	*E* reagent	np.	Yellow-brown
Phenylhydrazine	*F* reagent	np.	Amber
N,N-Dimethyl-*o*-toluidine	*E* reagent	np.	Red-brown
N,N-Dimethyl-*m*-toluidine	*E* reagent	< 2	Pale yellow
N,N-Diethyl-*m*-toluidine	*E* reagent	< 2	Dark brown-yellow
2,2′-(*m*-Tolylimino)diethanol	*TE*	< 24	Amber
2-Aminobenzenethiol	*C*	> 24	Dark (brown or black)
m-Dimethylaminophenol	*M* technical	> 24	Blue-black
m-Diethylaminophenol	*E* practical	> 24	Black
N,N-Dimethyl-*p*-toluidine	*E* reagent	< 1	Medium yellow
N,N-Diethyl-*p*-toluidine	*E* reagent	< 24	Yellow
p-Dimethylaminobenzaldehyde	*F* reagent	> 24	Yellow
p-Dimethylaminoazobenzene	*F* reagent	< 1	Red-brown
N,N-Dimethyl-*p*-phenylenediamine	*E* practical	> 24	Black
p-Diethylaminodiphenyl	*E* reagent	np.	——
N,N-Bis(γ-phenyl-*n*-propyl)-*p*-toluidine	*E* practical	> 24	Yellow
p-Chloro-N,N-diethylaniline	*E* reagent	< 2	Amber — dark on top
p,p′-Methylenebis (N,N-dimethylaniline)	*F* technical	< 1	Muddy yellow
p,p′-[*p*-Hydroxybenzylidenebis-(N,N-dimethylaniline)]	*E* reagent	np.	Red
p,p′-Benzylidenebis (N,N-dimethylaniline)	*E* reagent	< 1	Blue-green
p,p′,*p*″-Methylidynetris (N,N-dimethylaniline)	*E* reagent	np.	Purple
Dibenzylamine	*E* reagent	np.	Yellow-orange
α-Methylbenzylmonoethanolamine	*C & C*	np.	——
Benzyldimethylamine	*R & H*	np.	——
α-Methylbenzyldiethanolamine	*C & C*	> 24	Medium yellow
N,N-Dimethyl-1-naphthylamine	*E* reagent	> 24	Colorless
Tribenzylamine	*E* reagent	> 24	Colorless

(Continued on facing page)

Table I: Polymerization of methyl methacrylate in the presence of various amines, cont'd.

Benzoyl peroxide concentration 2%
Amine concentration........... 2%

Amines	Source[a]	Setting time hr.	Color
Aliphatic amines			
Ethylenediamine	*E* reagent	np.	——
Di-*n*-propylamine	*E* practical	np.	Deep rose
Di-isopropanolamine	*E* practical	np.	Dark
Di-isobutylamine	*E* reagent	np.	——
Di-*sec*-butylamine	*E* reagent	np.	——
Di-*n*-hexylamine	*E* reagent	np.	——
Dicyclohexylamine	*E* practical	np.	Dark
N-Methylcyclohexylamine	*D*	np.	Amber
Diethylenetriamine	*E* technical	> 24	Yellow
Triethylenetetramine	*E* technical	> 24	Yellow
Hexamethylenetetramine	*E* reagent	np.	——
Dimethylaminoethanol	*R & H*	> 24	Layered, red to yellow
Triethanolamine	*E* reagent	< 4	Brown-yellow
2-Di-*n*-butylamino-1-propanol	*E* practical	np.	Brown
Tri-isopropanolamine	*E* practical	> 24	Yellow
Tri-*n*-butylamine	*E* practical	> 24	——
Tri-*n*-hexylamine	*E* reagent	< 2	Pale yellow
N,N-Diethylcyclohexylamine	*E* practical	np.	Dark
N,N-Dimethyldodecylamine	*A*	> 24	Medium yellow
N,N-Dimethyl tallowamine	*A*	np.	——
Armeen 2HT	*A*	> 24	Mauve to pale yellow
Amine C	*Al*	> 24	Dark amber
Amine S	*Al*	> 24	Dark amber
Sequestrene Na-2 (disodium ethylenediamine tetraacetate dihydrate)	*Al*	> 24	Colorless
Petrolite wax amine C	*P*	> 24	Pale yellow
Petrolite wax amine B	*P*	> 24	Pale yellow
Petrolite wax amine A	*P*	> 24	Pale yellow
Diethylthiocarbamylchloride	*S*	> 24	Pale yellow
Heterocyclic amines			
2-(2-Dimethylaminoethylamino)-pyridine	*Mo*	np.	——
Piperidine	*F* reagent	np.	Dark
Pyrrole	*F* reagent	np.	Black
Pyrrolidine	*E* practical	np.	Dark
N-Phenylmorpholine	*E* practical	< 2	Pale yellow
Phthalamide	*E* reagent	np.	Colorless

[b] np. = no polymerization took place within 48 hours.
[a] = Code to source:
Al = Alrose Chemical Co.
A = Armour and Co.
C & C = Carbide and Carbon Chemical Co.
C = American Cyanamid Co.
D = E. I. du Pont de Nemours & Co.
E = Eastman-Distillation Products Industries.
F = Fisher Scientific Co.
M = Matheson, Coleman & Bell.
Mo = Monsanto Chemical Co.
P = Petrolite Corporation, Ltd.
R & H = Rohm and Haas Co.
S = Sharples Chemical Co.
TE = Tennessee Eastman Co.

Ultrasonic measurements of the polymerization rate have the advantage of ease of manipulation, speed, and simplicity. The Ultra-Viscoson reads in viscosity times density (cp.-g./cm.^{3}) units. These readings are affected by the following factors: 1) temperature rise of the exothermic polymerization reaction; 2) increase in density on polymerization; and 3) modulus of rigidity of the solution which may not be negligible in comparison to its coefficient of viscosity.

Some of these variables will compensate each other. The course of polymerization showed extremely large variations of the viscosity-time curves in the presence of the different amines. Because of this, it is unlikely that the above-mentioned variables (for which corrections are difficult to make) will greatly affect the results of this study. Hence, no corrections were made for these factors. Accurate measurements of the polymerization kinetics are preferably made by more time-consuming procedures such as dilatometric methods.

Test methods

Setting time of monomer: Preliminary studies were made using 18- by 150-mm. test tubes with 5-ml. monomer solutions containing 0.1 g. benzoyl peroxide and 2% by volume of the amine under investigation. These solutions were maintained at 37 ± 1° C. in an air bath. The test tubes were inverted at various time intervals until polymerization was evidenced by a marked increase in the viscosity. The time after which no further flow of the polymerized specimens could be observed was denoted as setting time. The color of the polymeric product was noted.

The setting time of monomer containing 2% benzoyl peroxide and various concentrations of dimethyl-*p*-toluidine was determined by the same procedure. The test tubes were maintained at 21 ± 1° C.

Polymerization of the amine solutions that set within 2 hr. was followed by means of the Ultra-Viscoson. About 22 ml. of the monomer solution containing known concentrations of benzoyl peroxide and amine were placed in a Pyrex test tube (18 by 150 mm.) in an air bath regulated to 37 ± 1° C. The Ultra-Viscoson probe was immediately inserted. Care was taken to ensure that the reed of the probe did not touch the sides of the tube at any time. Reading of the Ultra-Viscoson, which had been allowed to "warm up" for at least 1 hr. prior to the insertion of the probe into the solution, was started at 1 min. after the immersion of the probe. Readings were taken every minute or two, depending on the speed of the reaction, for the first hour and then at 5-min. intervals;

Table II: Polymerization of methyl methacrylate with benzoyl peroxide – amine systems

Benzoyl peroxide concentration — 2%

Amine	Time to reach viscosity shown below at various amine concentrations[a] 5.0 cp.-g./cm.³ 0.5% min.	5.0 cp.-g./cm.³ 1.0% min.	5.0 cp.-g./cm.³ 2.0% min.	100.0 cp.-g./cm.³ 0.5% min.	100.0 cp.-g./cm.³ 1.0% min.	100.0 cp.-g./cm.³ 2.0% min.	1000 cp.-g./cm.³ 0.5% min.	1000 cp.-g./cm.³ 1.0% min.	1000 cp.-g./cm.³ 2.0% min.
N,N-Dimethylaniline	42	18	12	75	26½	21½	—	35	43
N,N-Diethylaniline	45	—	19	70	43	29	100	63	41
p-Chloro-N,N-diethylaniline	np.	np.	33	np.	np.	44	np.	np.	61
2,2′-(Phenylimino)diethanol	np.	30	20	np.	42	25	np.	45½	32
N,N-Dimethyl-*o*-toluidine	np.	np.	np.	np.	np.	np.	np.	np.	np.
N,N-Dimethyl-*m*-toluidine	np.	10½	7	np.	21	23	np.	30½	100
N,N-Diethyl-*m*-toluidine	19	16	14	44	32	30	73	52½	110
2,2′-(*m*-Tolylimino)diethanol	11	12½	10	14	17	13½	np.	19½	np.
N,N-Dimethyl-*p*-toluidine	10	8	5	21½	18	46	34	34	185
Di(γ-phenyl-*n*-propyl)-*p*-toluidine	np.	13	np.	np.	41	np.	np.	np.	np.
Tri-*n*-hexylamine	39	29	20	np.	113	76	np.	119	88
Triethanolamine	25	np.	77	120	np.	200	np.	np.	215

[a] np. = no polymerization took place.

measurements were usually discontinued when the material reached a viscosity of about 2000 cp.-g./cm.³ so that the probe could be removed.

Setting time of monomer-polymer slurries: In order to determine the setting time of monomer-polymer slurries, 1 ml. of monomer solution containing different amine concentrations was mixed at room temperature with 1 g. of polymer powder containing 1% benzoyl peroxide. The rate of hardening was measured in air at room temperature and at 37 ± 1° C. using the modification of the A.S.T.M. penetration test D5-25 described by Brauer and Burns (24).

Evaluation of physical properties: The Rockwell Superficial Hardness Tester was used to determine the indentation and recovery of polymeric products. One milliliter of monomer containing 1 or 2% amine and 1 g. of polymer containing 1% benzoyl peroxide were mixed. Indentation and recovery values were obtained after the mixture had been held at 37° C. for 10 min., 30 min., 1 hr., 3 hr., 1 day, 3 days, and 5 days by the procedure of Sweeney, Sheehan, and Yost (25).

Efficiency of commercial amine accelerators

The results of the preliminary experiments on the efficiency of commerically available amine accelerators are given in Table I. It

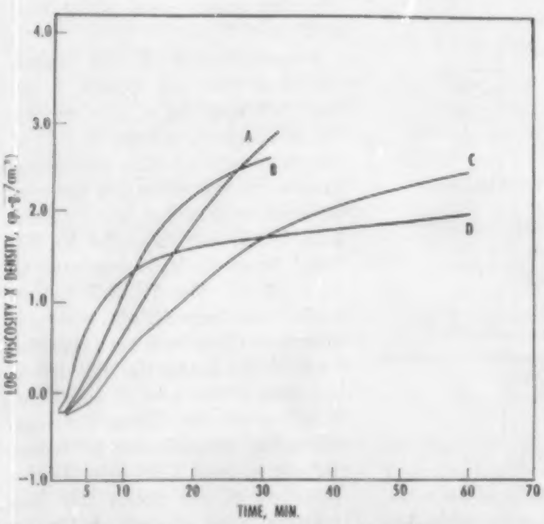


Fig. 4: Polymerization of methyl methacrylate in presence of various concentrations of N,N-dimethyl-*p*-toluidine. Temp.—37° C.; benzoyl peroxide conc.—2%; N,N-dimethyl-*p*-toluidine conc.—A: 0.50%, B: 1.00%, C: 0.25%, D: 2.00%

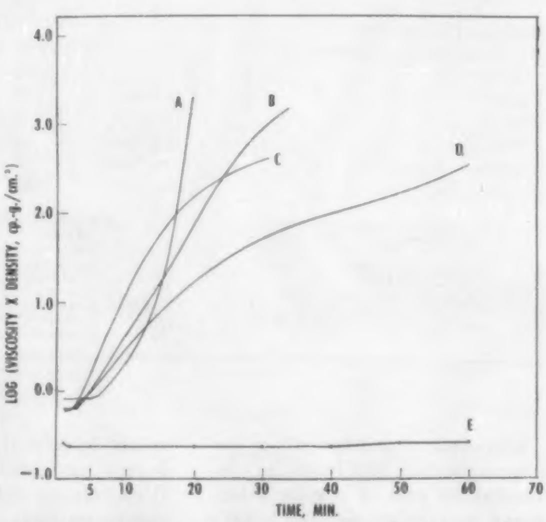


Fig. 5: Polymerization of methyl methacrylate in presence of substituted toluidines. Temp.—37° C.; benzoyl peroxide conc.—2%; toluidine conc.—1% A: 2,2′-(*m*-Tolylimino) diethanol; B. N,N-dimethyl-*m*-toluidine; C: N.N-dimethyl-*p*-toluidine; D: di(γ-phenyl-*n*-propyl)-*p*-toluidine; E: N,N-dimethyl-*o*-toluidine

BAKELITE Plastics

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From left to right: In this busy scene, one man cuts sod and digs trench, another handles lightweight coil of 1½-in. polyethylene pipe singlehanded, supervisor studies plot plan, and others fit polyethylene pipe to sprinkler joints.

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Bakelite Company can offer a wide choice of materials to explore in your search for a plastic to fit your product needs. Here you have the advantage of working with the greatest variety of plastics and resins in the field—all available through a single convenient source.

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(continued on next page)

60 per cent sturdier seats molded from BMG-5000

Big aid to plastics selection

(continued from preceding page)

Extruded polyethylene brings savings to lawn sprinkling systems

The planned advantages of this lawn sprinkling system include the use of pipe extruded from BAKELITE Brand Polyethylene. Installation is relatively simple. There's seldom need for elbows because the flexible pipe can bend around corners. It can be cut with a knife or hacksaw and clamped to the metal sprinkler fittings. In winter, freeze-up is minimized by the inherent resilience of the polyethylene.

Extrusions of BAKELITE Polyethylene range from large-diameter pipe to small tubes used in medical packaging. A recent Bakelite Company development has resulted in a polyethylene that can be extruded into sheets for vacuum-forming large-size sections.

Sprinkler installation by John A. Brooks, Inc., Detroit, Mich., uses pipe extruded by Johnson Plastic Corp., Chagrin Falls, Ohio.

Colorful vacuum cleaner parts are made with elastomeric vinyl

Color, gloss, and resilience are properties of molded BAKELITE Brand Elastomeric Vinyl Plastic that make this material ideal for vacuum cleaner parts. Eureka-Williams Corp. uses BAKELITE Elastomeric Vinyl Plastic because its resilience saves furniture from knocks, dents, and scratches. Its flexibility permits snap-together assembly, while the built-in colors add age-resistant eye-appeal.

BAKELITE Elastomeric Vinyl Plastics are also used for toys, automotive parts, handle grips, pedal pads, and appliance cord plugs. These applications demonstrate several service properties, including good dielectric strength and resistance to water, oil, and chemicals. Several formulations of BAKELITE Elastomeric Vinyl Plastics are available, providing flexibility ranging from semi-rigid to soft, finishes that are glossy or matte, and translucent, transparent, or opaque color effects.

Vacuum cleaner parts molded by Plano Molding Co., Plano, Ill., for Eureka Williams Corp., Bloomington, Ill.

60 per cent sturdier seats molded from BMG-5000

Pressure deflection tests by the manufacturer showed that these seats molded of BAKELITE Brand Phenolic BMG-5000 were 60 per cent stronger than those molded of previous materials. Mechanical strength is just one advantage of BMG-5000. Another is its finish. With BMG-5000, costly buffing operations on these seats are eliminated, and the surface remains unimpaired after constant cleaning with strong caustic solutions. Plant rejects for all causes have fallen below one per cent. Result: a better product with simplified production techniques.

BMG-5000 is a general-purpose, two-step, wood-flour-filled material formulated for the best combination of molding and end use properties. It offers a very low specific gravity, broad molding latitude, excellent flow properties, and good hot rigidity. Besides its strength and appearance features, it provides low shrinkage, minimum warpage, and good electrical properties.

Seat molded of BAKELITE Brand Phenolic BMG-5000 by Sperzel Company, Minneapolis 8, Minn.

C-11 and phenolic plastics both serve the "Koffeekit"

Lid, base, and handle molded by The Plastics Molding Company, Inc., St. Louis 7, Mo., cups and spoons molded by Engineered Products, Kirkwood 22, Mo., for Jack Keefe Mfg. Co., St. Louis 10, Mo.

This plug-in coffee set employs two of the materials available from Bakelite Company—one convenient source. Cups and spoons are molded from BAKELITE Brand C-11 Plastic; lid, handles and base are BAKELITE Brand General-Purpose Phenolic BMG-5000.

C-11 Plastic is a styrene-acrylonitrile copolymer with excellent resistance to staining by coffee, tea, and citrus juice, as well as many other foods and chemicals. This material offers a wide range of colors, and possesses good transparency. In addition, its toughness enables the cups and spoons to withstand everyday handling.

BAKELITE Phenolic BMG-5000 is a general-purpose material that provides a fine finish and ebony color that complement the sheen of the aluminum pot. Strength and electrical resistance were factors in its selection for this product, and since it is also a good heat insulator, the molded base protects surfaces on which the pot may be set.

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these compounds produce poly- appreciable increase in viscosity, in the rate of bimolecular termi-

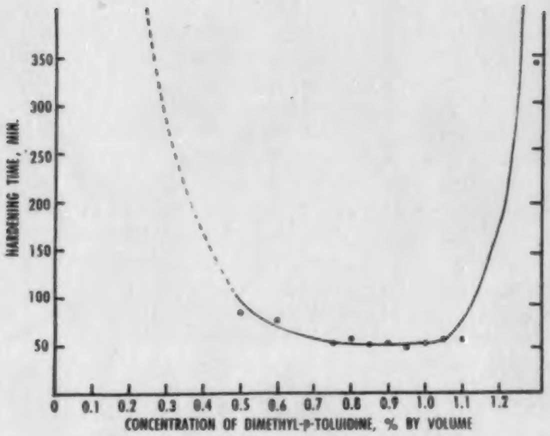

Fig. 6: Effect of accelerator concentration on the hardening time of self-curing resins. Temperature—21.1° C.; benzoyl peroxide concentration—2 percent

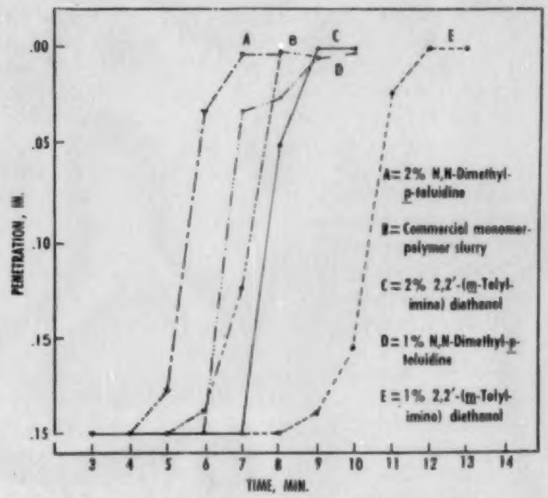

Fig. 7: Setting time of monomer-polymer slurries (penetration test). Mixture—1 g. ground polymer containing 1% benzoyl peroxide and 1 ml. of 0.006% hydroquinone-stabilized monomer. Temp.—37° C.

will be noted that only a small number of secondary or tertiary amines produce rapid polymerization during experiments.

Among the tertiary amines, N,N-dimethylaniline is an effective accelerator. The substitution of two β-hydroxyethyl groups for the methyl groups in N,N-dimethylaniline increases the polymerization rate. 2-N-Methylanilinoethanol and 2-N-ethylanilinoethanol show a much reduced efficiency. A methyl group substitution in the ortho position of dimethylaniline reduces the decomposition rate of benzoyl peroxide to such an extent that polymerization does not take place readily. An aliphatic group in the meta position increases peroxide decomposition as compared to the ortho-isomer (15).

Substitution of electron-repelling groups in the para position of dimethylaniline will increase the accelerating efficiency. In the presence of N,N-dimethyl-p-toluidine and N,N-dimethyl-p-phenylenediamine, the polymerization rate is very rapid. This is in agreement with Horner's mechanism since an increase in the electron density of the unshared pair of electrons of the nitrogen atoms of substituted dimethylanilines should produce a larger activating effect.

Table III: Setting time of monomer-polymer slurries as determined by penetration test

Mixture: One gram of ground polymer containing 1% benzoyl peroxide. One milliliter of hydroquinone-stabilized monomer containing amine in concentration indicated.

	Time of set at temperature and amine concentration shown below			
	37° C.		*22° C.*	
Amine	*1% min.*	*2% min.*	*1% min.*	*2% min.*
N,N-Dimethyl-p-toluidine	9	7	9½	9
2,2'-(m-Tolylimino)diethanol	12	9	24½	18
N,N-Diethyl-m-toluidine	14	11	—	—
N,N-Dimethylaniline	17½	12	—	19½
2,2'-(Phenylimino)diethanol	21½	15	—	—
N,N-Diethylaniline	—	18	—	—
Commercial monomer and polymer	8		14	

Electron - attracting groups such as aldehydes have a retarding effect on the polymerization rate. The slow rate of polymerization in the presence of N,N-diethyl-p-toluidine and p-diethylaminodiphenyl is unexpected. Horner and Scherf (14) showed that N,N-dimethylaniline and N,N-diethylaniline decompose benzoyl peroxide at approximately the same rate. Absorption of oxygen in the benzoyl peroxide-diethylaniline solutions is much slower and is one-fourth of that of the equivalent peroxide-dimethylaniline systems (18). Steric effects of the larger ethyl groups may reduce formation of a free radical similar to *D*. Formation of secondary peroxide would therefore be reduced. Rate of formation of free radicals by abstraction of a proton from the para position of the aromatic nucleus to form free radicals similar to *D'* is little affected by the presence of N,N-diethyl groups. This would explain the formation of equivalent amounts of p-benzoxy-N,N-dimethyl- and p-benzoxy-N,N-diethylaniline, respectively, and the same decomposition rate of benzoyl peroxide in the presence of the two amines (19).

Aromatic compounds with amine groups in the side chain, such as secondary and tertiary benzylamine derivatives, are poor polymerization accelerators. None of

these compounds produce polymerization in less than 24 hours. Since tribenzylamine rapidly decomposes benzoyl peroxide in solution (14), steric effects must again be responsible for the lowered reactivity. N,N-Dimethyl-1-naphthylamine, probably for the same reason, shows little accelerating efficiency.

With few exceptions, the aromatic amines form colored products which range from yellow for N,N-dimethyl-*p*-toluidine to black for N,N-dimethyl-*p*-phenylenediamine. Substituents that produce a deepening of the colors (bathochromic groups) often increase the polymerization rate. Introduction of a second dimethylaniline group in *p,p'*-benzylidenebis(N,N-dimethylaniline) produces a deepening of the color of the polymeric product.

Most aliphatic amines have little effect on the rate of polymerization. The decrease in reactivity compared with the aromatic amines may be due to the formation of a salt of the benzoic acid (which is formed from the decomposition of benzoyl peroxide) with the more basic aliphatic amine. Such a salt does not accelerate peroxide decomposition. In the presence of secondary amines, the solutions show no appreciable increase in viscosity, even on prolonged standing. Monomer solutions containing diethylenetriamine and triethylenetetramine polymerize after 24 hr. at 37° C. Tri-*n*-hexylamine is the most efficient of the tertiary aliphatic amines. Further increase in the aliphatic chain length increases the setting time. Products usually show a lighter shade than those polymerized with the aromatic amines.

Heterocyclic amines have little effect on the setting time. An exception is N-phenylmorpholine which, when added to monomer, gives a pale yellow polymer in less than 2 hours.

Viscometric study of polymerization rate

The course of the polymerization in the presence of the more efficient benzoyl peroxide-amine systems was followed viscometrically. A summary of the results is given in Table II, p. 158 and Figs. 4 and 5, p. 158. After a short induction period, the polymerization rate increases rapidly. Some curves show an increase in rate after a considerable amount of polymer has been formed. This effect is caused by a rise in temperature due to the exothermic polymerization reaction. It can also be attributed to a decrease in the rate of bimolecular termination of growing chains with increasing viscosity of the monomer-polymer medium (26-28).

Eventually the concentration of free radicals or monomer becomes very low. Chain growth and termination become small, resulting in a levelling off of the viscosity-time curves. Variations in the ratio of the benzoyl peroxide–dimethyl-*p*-toluidine concentration greatly change the location at which the slope of the curves becomes small (Fig. 4).

N,N-Dimethylaniline is a more efficient accelerator than the diethyl, di(β-hydroxyethyl), or *p*-chloro-N,N-diethyl derivatives. The substituted toluidines (Fig. 5) show a rapid initial rise in viscosity. Complete polymerization is not reached with di(γ-phenyl-*n*-propyl)-*p*-toluidine. With 2,2'-(*m*-tolylimino) diethanol, a 1000 cp.-g./cm.[3] reading is reached in the shortest period of time (19½ minutes). No levelling off in this viscosity-time curve is observed.

The effect of the different concentrations of N,N-dimethyl-*p*-toluidine on the rate of polymerization is shown in Fig. 4. A 2% solution of the amine has the largest initial polymerization rate but the increase in viscosity with time becomes small in the

Table IV: Indentation of polymers during storage

Amine	Depth of indentation[a] for specimen aged 10 min.	30 min.	1 hr.	3 hr.	1 day	3 days	5 days
	mm.	mm.	mm.	mm.	mm.	mm.	mm.
N,N-Dimethyl-*p*-toluidine							
1%	—	0.223	0.148	0.135	0.107	0.106	0.099
2%	0.216	0.190	0.133	0.115	0.109	0.099	0.093
N,N-Diethyl-*m*-toluidine							
1%	—	—	0.167	0.144	0.120	0.102	0.096
2%	—	—	0.149	0.134	0.115	0.106	0.098
2,2'-(*m*-Tolylimino)diethanol							
1%	—	—	0.145	0.124	0.108	0.108	0.099
2%	—	0.188	0.133	0.119	0.111	0.098	0.101
N,N-Dimethylaniline							
1%	—	—	0.184	0.162	0.125	0.107	0.101
2%	—	—	0.174	0.143	0.128	0.104	0.097
N,N-Diethylaniline							
1%	—	—	0.215	0.157	0.129	0.104	0.096
2%	—	—	0.185	0.152	0.119	0.104	0.097
2,2'-(Phenylimino)diethanol							
2%	—	—	0.164	0.142	0.120	0.103	0.098

[a] Average of at least two specimens. Major load applied for 10 minutes.

Table V: Recovery[a] of polymers during storage

Amine	*10 min.*	*30 min.*	*1 hr.*	*3 hr.*	*1 day*	*3 days*	*5 days*
	Recovery of specimen aged						
	%	%	%	%	%	%	%
N,N-Dimethyl-*p*-toluidine							
1%	*	36	48	53	69	71	76
2%	22	34	48	64	70	76	79
N,N-Diethyl-*m*-toluidine							
1%	*	*	44	53	63	75	76
2%	*	*	46	53	66	74	78
2,2′-(*m*-Tolylimino)diethanol							
1%	*	*	48	58	69	67	72
2%	*	40	53	61	70	76	77
N,N-Dimethylaniline							
1%	*	*	36	45	58	70	73
2%	*	*	41	52	63	69	78
N,N-Diethylaniline							
1%	*	*	33	46	59	73	74
2%	*	*	40	49	65	72	77
2,2′-(Phenylimino)diethanol							
2%	*	*	42	53	63	71	74

[a] Recovery computed as percent of indentation depth recovered 10 min. after the major load (30 kg.) was released and minor load (3 kg.) remained. Average of at least two determinations.
* Too soft to measure.

neighborhood of 50 cp.-g./cm.³. Solutions containing 0.25, 0.50, and 1% amine have similar increases in viscosity below 1 cp.-g./cm.³. After 5 min., more rapid polymerization takes place for the 0.50 and 1% solutions. From Fig. 6, p. 163, showing the effect of the accelerator concentration on the hardening time of the monomer, it will be seen that the amine concentration between 0.75 and 1.0% gives the shortest setting time. Further increase or decrease in the amount of amine dissolved in the monomer produces a very rapid increase in the setting time.

Monomer-polymer slurries

The setting time of each monomer-polymer slurry is given in Table III, p. 163. Typical penetration-time curves are shown in Fig. 7, p. 163. Mixtures containing 2% amine concentration in the monomer set faster than those containing 1% amine. With 2% N,N-dimethyl-*p*-toluidine in the monomer, polymerization is fastest. On increasing the polymerization temperature from 22 to 37° C., a shorter setting time is observed. Relative efficiencies of amines in the polymerization of monomer do not always correlate with those obtained for monomer-polymer slurries. 2,2′-(Phenylimino)diethanol and 2,2′-(*m*-tolylimino)diethanol show a lower relative activating efficiency in monomer-polymer slurries. The reason for this lack of correlation cannot be explained readily. Hagger (29) has suggested that the heat of swelling of the polymer powder particles initiates polymerization. It is conceivable that uncoiling of the polymer chains and the subsequent expansion (swelling) of the network may vary in the presence of different amines and amine concentrations. The possibility that the rate of solution of benzoyl peroxide, which is incorporated in the powder, varies somewhat in the different amines must also be considered. The relative rate of reaction of free radicals with monomer and polymer chains and the chain transfer rate may also be altered by varying the amine.

Physical properties of the polymers

In order to evaluate the physical properties of the polymer specimens, indentation and recovery were determined. Results of these measurements are shown in Tables IV, p. 164, and V. With 1% amine concentration in the monomer, most products are too soft to measure at 30 minutes. After 1 hr., the specimens polymerized with 2,2′-(*m*-tolylimino) diethanol have the lowest indentation and the highest recovery values. Values for N,N-dimethyl-*p*-toluidine follow closely. Otherwise, the results correlate well with the setting time data; the longer the setting time, the larger the indentation and the smaller the recovery. Specimens polymerized with the different amines show little variation in indentation at 5 days. Recovery values of products of the slower setting amines are slightly lower than those for N,N-dimethyl-p-toluidine. With 2% amine concentration, polymerization occurs more rapidly as evidenced by the lower indentation and higher recovery values after one hour. Five-day indentation values for the specimens polymerized with N,N-dimethyl-*p*-toluidine are lowest. In the presence of the other amines, indentation and recovery are slightly poorer and show little variations for the various amines. Generally, solutions that are polymerized with 2% amine show improved physical properties compared with those polymerized with 1% amine. The data are in agreement with previous studies which show that the molecular weights of the polymer

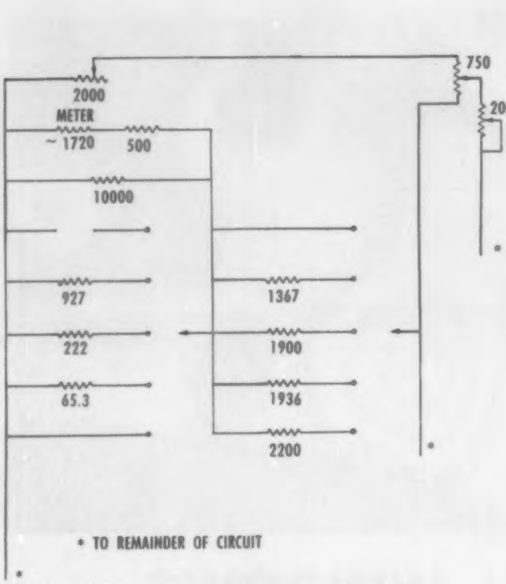

Fig. 8: Circuit diagram of the multiplying resistances which were used in the original circuit of the Ultra-viscoson

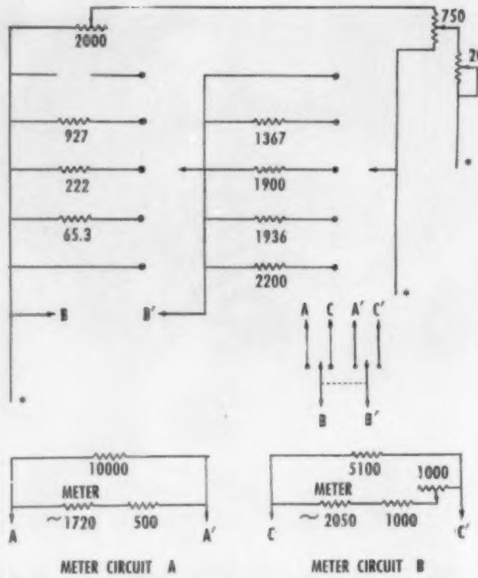

Fig. 9: Modified circuit, showing original circuit and added resistance meter circuit for the 0- to 5-cp.-g./cm.³ range

formed increase with an increase in the polymerization temperature (30,31). Since the faster setting resins have higher peak temperatures (32), improved indentation and recovery values should be expected.

Appendix

The model XV Ultra-Viscoson (23), developed by the Rich-Roth Laboratories, was modified to increase the range of the instrument and to expand the lower scale readings below 1 cp.-g./cm.³.

A simple circuit was designed to achieve this result without requiring an extensive modification of the basic instrument. The original circuit is illustrated in Fig. 8, above, and the modified circuit in Fig. 9, above. In the interest of clarity, only the multiplier circuits are displayed.

The basic instrument is so designed that the full-scale readings are 50, 500, 5000, and 50,000 cp.-g./cm.³. The new circuit was designed so that the full-scale reading would be 5 cp.-g./cm.³.

The instrument determines an analog of α, the decay constant of the vibrating reed in the material, which is proportional to the square root of the fluid's viscosity-density product; therefore, the scale is not linear but parabolic, i.e., a reading of 5 is $1/\sqrt{10}$ of the indicator travel for a reading of 50 on the same range.

For any range of the instrument, the voltage across the meter circuit *A* is the same for any full-scale deflection and is given approximately by $(1720+500)I_M$, where I_M is the full-scale reading in amperes. The meter of this instrument is a 100-microampere meter, hence this voltage is approximately 0.222 volt. If the meter reading is (full scale)/10^n, the voltage across the meter circuit A is given by:

$$V = 0.222/10^{n/2}$$
$$n = 0, \pm1, \pm2, \ldots$$

For a meter whose full-scale reading is I'_M amperes, the resistance of the meter branch is:

$$R_M = V/I'_M = 0.222/(I'_M \cdot 10^{n/2})$$

In our case, n=1, or

$$R_M = 0.222/(I'_M \cdot 10^{1/2}) = 0.0702/I_M$$

A Triplett 20-microampere meter was found to be satisfactory, since it had a resistance of approximately 2050 ohms and

$$R_M = (0.0702)10^6/20 \text{ ohms} = 3510 \text{ ohms.}$$

The remainder of the resistance required for this branch is compensated for by the use of a 1000-ohm carbon resistor and a 10-turn 1000-ohm potentiometer.

It is desirable that circuit *B* have approximately the same resistance as circuit *A* for matching impedances, but this has not been found to be very critical. A resistance of circuit *B* of the order of 2000 ohms, is satisfactory.

Calibration is accomplished easily by unbalancing the instrument by means of 750-ohm and 2000-ohm potentiometers, illustrated in the circuit diagrams and known as the coarse- and fine-zero set, respectively. The instrument is unbalanced to read 5 cp.-g./cm.³ by meter circuit *A*. Meter circuit *B* is then switched into the main circuit and, by adjusting the 10-turn potentiometer, is made to read 20 microamperes. The instrument is then balanced by means of the zero set to read zero on meter circuit *B*. Readings may then be taken. To convert the readings in microamperes to cp.-g./cm.³, the following formula is used:

(reading in cp.-g./cm.³)/(full-scale reading in cp.-g./cm.³) = (reading in microamperes)²/(full-scale reading in microamperes)²

The calibration was checked by

(*To page* 256)

An autographic apparatus for the study of

Thermal Distortion

By M. T. Watson, G. M. Armstrong,* and W. D. Kennedy**

As part of a program on physical testing of polymeric materials, an apparatus was designed and fabricated for plotting autographically the thermal-distortion behavior of molded plastics, extruded and cast films, and yarns.

Curves obtained on injection- and compression-molded plastic specimens are shown to yield information regarding effects of molding treatment, plasticizer content, and crystallization. Curves for film and yarn specimens show the effects of orientation and crystallization.

The apparatus described permits recording of thermal-distortion behavior on as many as five specimens simultaneously with considerable versatility as to specimen type. Operation of the apparatus after start of a test is nearly automatic. It has proved to be a useful tool for evalution of thermal-distortion behavior of polymeric materials.

The ability of plastics to withstand elevated temperatures without permanent changes in dimensions has become increasingly important in a variety of applications. The conventional method of measuring this property is A.S.T.M. test D 648-45T, "Heat-Distortion Temperature of Plastics" (1),[1] in which a plastic specimen is supported as a simple beam and a specified load is applied to its center. The temperature of the liquid bath in which the sample is immersed is caused to rise at the rate of 2° C. per minute. The heat-distortion temperature is taken as that at which the center of the specimen has deflected 0.010 inch.

Apparatus is available commercially for running five specimens simultaneously, and the apparatus could be provided with recording deflectometers. However, the test is limited to rather large bars as specimens and to bending deformation.

It is often desirable to use smaller specimens, prepared by extruding, molding, casting, and machining, and to test them in a variety of ways. In particular, heat-distortion tests in tension, using injection-molded specimens, specimens cut from extruded and cast sheets, or yarn samples, have been found to be particularly informative for research purposes.

This paper describes a new thermal-distortion apparatus designed to record automatically the elongation-versus-temperature behavior of as many as five specimens simultaneously. These specimens are mounted in a forced-convection oven in which the temperature is caused to rise at a controlled rate, as much as 2° C. per minute. An important consideration was the desirability of having the operation, after the run is started, as fully automatic and self-regulating as possible. Versatility of the apparatus is demonstrated by results of thermal-distortion tests on injection- and compression-molded specimens in tension and in flexure, on cast and extruded films in tension, and on yarn in tension.

Apparatus

As shown in Fig. 1, below, the apparatus consists of a forced-convection oven, electrically heated; suitable specimen clamps and jigs by means of which the specimens are supported within the oven; the electric servo systems which respond to changes in

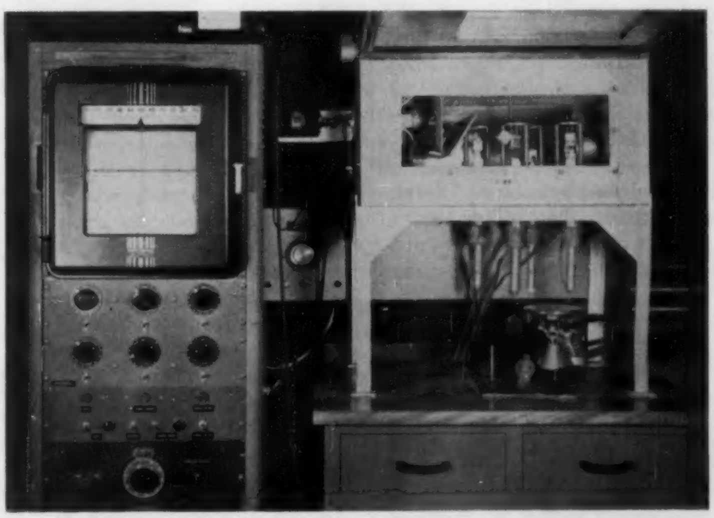

Fig. 1: Over-all view of autographic heat-distortion apparatus

Presented in part at the 121st meeting of American Chemical Society, Milwaukee, Wis.
*Research Laboratories, Tennessee Eastman Co., Div. of Eastman Kodak Co.
[1]Numbers in parentheses link to references at end of article, p. 259.

specimen dimensions; controls for the servo systems; apparatus for controlling the rate of heat input to produce a linear rate of temperature rise; and a recorder which plots specimen deformations versus time. The relay rack includes, from top to bottom, a six-point Speedomax recorder,[2] servo controls, main heater controls, and a MacDonald temperature regulator.[3]

The forced-convection oven is constructed of two concentric boxes, the inner of aluminum plate, the outer of Transite, with the 2-in. space between them filled with vermiculite. The counter-weighted door and the rear of the oven are provided with double Pyrex plate glass windows. Through the bottom of the oven five openings are provided to accept the turrets in which specimens are placed. Above each turret is a 1-in. hole, normally closed, by means of which apparatus may be suspended within the oven.

The oven is heated by means of five 500-w. Chromalox strip heaters and an open Nichrome coil of approximately 600-w. capacity near one end of the oven. A fan is mounted in such a way that air is circulated first over the main heaters and then through the coil which is controlled by the MacDonald regulator. The air is returned to the heaters from below through a gap between the Transite bulkhead on which the coil heater is mounted and the bottom of the oven.

Temperature increase at a linear, predetermined rate during a test is accomplished by switching on the 500-w. heaters in succession and by adjusting the control point of the MacDonald regulator continuously. The switching is accomplished by means of a series of microswitches, adjustable in position along the path of a slowly moving bar which closes each switch as it passes. The positions of the switches were determined by trial and error and are not critical.

The temperature-sensing element is a resistance thermometer which is connected in a Wheat-

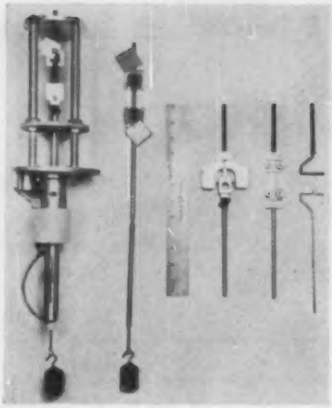

Fig. 2: Details of turrets, clamps, LVDT, specimens.

stone bridge circuit with a 10-turn potentiometer that is a part of the MacDonald instrument. A 10-turn dial, calibrated in degrees Fahrenheit is attached to the potentiometer shaft. The degree of unbalance of the Wheatstone bridge determines the amount of control current supplied to the Nichrome heater coil. The MacDonald regulator was modified by addition of a Telechron synchronous gear motor, a train of gears, and a clutch, so that the dial and shaft of the control potentiometer are advanced at the required rate.

Good linearity of temperature rise is achieved by these means, although the rate of increase corresponds only approximately to the calibration of the control dial. If this were a serious defect, it could be rectified by altering trimming resistors at the two ends of the control potentiometer.

The temperature uniformity within the oven, at least at the locations of specimens, is quite good. It was observed, however, that specimens close to the coil heater deformed earlier than similar ones located farther from the heater, apparently because of radiation from the coil. This difficulty was corrected by interposing a baffle so arranged as to deflect the stream of air and shield the specimens from radiation.

Five turrets, four of which are shown in test position in Fig. 1, permit five specimens to be run simultaneously. These turrets are fastened to the base plate of the oven and can be easily removed. The turret is shown in greater detail in Fig. 2, left, along with the various types of specimen clamps. Through the top-most turret plate, a screw with knurled nut and locking nut is inserted and is fastened to the upper clamp. Rotation of the knurled nut causes adjustment of the position of the upper clamp and therefore of the armature of the linear variable differential transformer (LVDT).[4] To the bottom-most plate of the turret is fastened a clamp which holds the LVDT. Connections to the LVDT are made by means of a Jones plug, one part of which is mounted on the base plate of the turret. Only aluminum and brass, which are nonmagnetic, were used in the turrets and clamps in order to avoid distortion of the magnetic field of the LVDT coils. The LVDT itself is isolated from the turret by a Synthane adapter.

The lower clamp is attached by an aluminum extension rod to the armature of the LVDT. The clamps for molded specimens are provided with cover plates and fit the ends of the specimens quite closely. Two types of clamps are provided to fit the two types of molded tensile specimens used.

The usual type of molded tensile specimen is ¼ in. thick and has a center section ¼ in. wide and 1 in. long which flares out to join ¾-in. square ends. The other type is ⅛ in. thick and has a center section ¼ in. wide and 1 in. long which flares out to join ½-in. square ends.

Film specimens of almost any size, depending on thickness and desired stress to be used in the test, can be cut from extruded or solvent-cast sheets. For films 1 to 10 mils thick, a convenient size is ½ to 1 in. wide with about a 1-in. gage length. The clamps for such film strips, shown in Fig. 2, are fabricated from two small aluminum plates which are screwed together to hold the end of the film strip between them.

It is also possible to measure heat-distortion behavior of yarns by looping a continuous length of yarn several times around the two horizontal rod clamps, shown in Fig. 2, and then tying the two ends together. The approximate

[2]Manufactured by Leeds and Northrup Co., Philadelphia, Pa.
[3]Manufactured by W. S. MacDonald Co., Cambridge, Mass.
[4]Manufactured by Schaevitz Engineering Co., Camden, N. J.

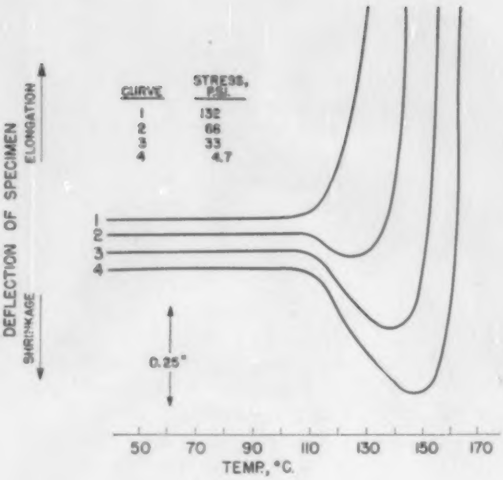

Fig. 3: Effect of varying the load on four identical specimens of injection molded polymethyl methacrylate

initial stress can be computed from the external load and the length, density, and denier of the yarn.

Tests on distortion in bending may be made by means of a jig which is used in place of the tensile clamps. In this jig the specimen rests on two cylindrical pins and the load is supplied through a third pin resting on the center of the specimen. The specimens are commonly ½ by ⅛ by 2½ in. and may be injection molded or milled from sheet stock.

The loads on the specimens are applied by hanging weights on the lower ends of the LVDT armatures, the minimum load being about 70 grams. Loads less than this can be attained by counterbalancing the lower ends of the LVDT armatures with suitably placed laboratory balances.

By using a steel prototype specimen, it was determined that expansions of the apparatus contribute no observable part of the deformations observed with plastic specimens. With the steel specimen, the small expansion observed corresponded approximately to the thermal expansion of the steel. This means that the turret construction compensates for its own thermal expansion.

The servo system is based upon the use of LVDT's by means of which the mechanical motion of the transformer core, which is linked to the specimen, is transformed into an electrical a.c. potential. Attached to the slidewire shaft of a six-point Leeds and Northrup Speedomax is a cam that by rotation advances and retracts the armature of an LVDT. At balance, the unbalanced outputs from the two secondary windings of this LVDT are opposed by an equal unbalance of the secondary windings of the transmitter LVDT, the armature of which is connected to the specimen. That is, the displacement of the armature in the recorder from its null position is identical to that of the armature in the transmitter, if the primary exciting voltages are equal. The cam is so designed that one revolution of the slidewire shaft, which corresponds to 10 in. of chart width, also corresponds to a 2-in. displacement of the transmitter armature under these conditions. Fivefold magnification is thus obtained.

To provide for various magnifications, each of the LVDT primaries is excited by current from a 6-v. transformer, the primary of which is connected to the output of a Type 300 B Variac.[5]

[5]Manufactured by General Radio Co., Cambridge, Mass.

The primary of the recorder LVDT is excited by about 1.5 v. from a small transformer.

Molded plastics

Figure 3, left, is a tracing made from the Speedomax chart obtained with four identical specimens of injection molded polymethyl methacrylate, the load applied being different in each case. The vertical axis is that of specimen distortion, the zero of distortion being taken as the initial reading in each case. Temperature, as calculated from the measured rate of temperature rise in the test, is plotted linearly along the horizontal axis. Although provision is made for five channels, only four were operative at the time of the test depicted.

The stresses corresponding to the loads applied, calculated on the original cross section of the specimens, are indicated on the graph; these stresses varied from about the minimum, corresponding to the weight of clamp, extension, and LVDT armature, to 132 p.s.i., for which an additional load of 3200 g. was required.

With small external stress, injection molded specimens undergo a characteristic shrinkage following initial reversible thermal expansion and preceding the partly irreversible flow which takes place at sufficiently high temperatures. This shrinkage is due to locked-in, non-equilibrium strains which occur in injection molding. As the applied stress is increased, the tendency to shrink is partially compensated for until ultimately no shrink is observed, as was the case in Fig. 3 when the applied stress was 132 p.s.i. At the next lower stress, 66 p.s.i., the shrink was not quite compensated

Table I: Heat-distortion temperatures of injection-molded polymethyl methacrylate[a]

Stress	*Heat-distortion temperature* — *From tangent method*	*From offset method*
p.s.i.	°C.	°C.
4.7	113	103
33	110	109
66	112	106
132	112	103

[a]A.S.T.M. heat-distortion temperature=100.5° C. at 66 p.s.i.

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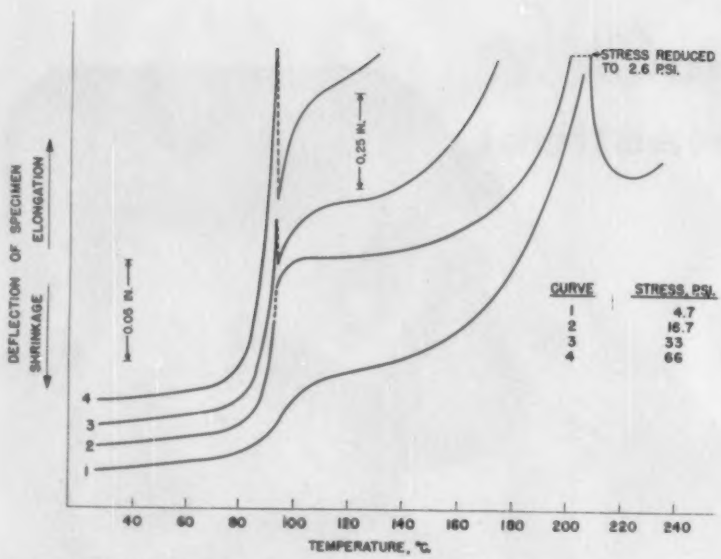


Fig. 4: Heat distortion of cast polymethyl methacrylate

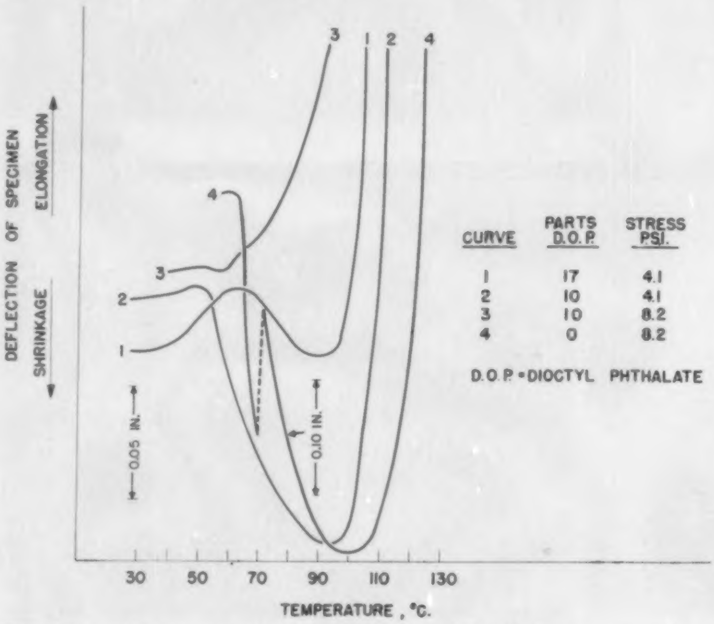


Fig. 5: Heat distortion of injection molded polyvinyl chloride

for. It can therefore be concluded that the magnitude of the locked-in stresses amounted to something over 66 p.s.i. and considerably less than 132 p.s.i.

The amount of shrink is dependent upon the molding conditions, such as mold temperature, specimen cross section, cylinder temperature, and rate of injection, as well as upon the applied stress in the heat-distortion test.

As the temperature continues to increase, the shrinking ceases and elongation begins, at first gradually, then more rapidly. In most cases the specimen finally ruptures after marked reduction of cross section.

These heat-distortion curves are characterized by three parameters: the temperature of initial deformation, referred to the practically linear thermal expansion; the magnitude of the shrink, referred to the initial gage length; and the temperature of rapid flow.

The early, nearly linear expansion of the specimen is largely due to thermal expansion and is therefore completely reversible. From the measurements at the two lowest applied stresses, the calculated coefficient of expansion is $9.5 \times 10^{-5}/°C.$, which is in good agreement with published values for this plastic. At the higher stresses, the slope is greater, by as much as 45% at 132 p.s.i. This part of the linear expansion is presumably due to elastic stretch with decreasing modulus of elasticity as the temperature rises.

To choose a temperature that can be referred to as the heat-distortion temperature requires an arbitrary definition. Two choices have been considered here. The point of intersection of the tangents to the slowly expanding and rapidly shrinking (or stretching) parts of the curve is one arbitrary choice, and a second may be made in terms of the temperature of an arbitrary amount of deformation from the early straight line part of the curve. For small deformations the second temperature is lower than the first.

In Table I, p. 172, heat-distortion temperatures obtained by both methods of computation are given for each of the four values of stress. The last column is the temperature at which a deformation of 0.0025 in. was observed, referred to a straight line through the first part of the curve. The A.S.T.M. heat-distortion temperature, at 66 p.s.i. stress, is reported by the manufacturer to be 100.5° C.

In a second series of tests, using specimens injection molded from the same polymethyl methacrylate but with better molding conditions, no shrinkage was observed even at 6 p.s.i. stress. In these experiments, the heat-distortion temperature obtained by either method depended upon the stress, the value at 66 p.s.i. by the tangent method being 103° C.

A similar series of tests on specimens cut from cast polymethyl methacrylate sheet was run. Some of these curves are shown in Fig. 4, above, which was traced from the original chart. The character of these curves is very different from those obtained with injection molded specimens. The heat-distortion temperature by both tangent and offset meth-

ods depends upon the stress ap- In Fig. 5, p. 174, the heat-dis- containing 17 parts of dioctyl

ods depends upon the stress applied. These curves are distinguished from those shown previously in that each curve levels off to a plateau after an initial rapid distortion, and this plateau persists to high temperatures. Rapid flow, which characterizes the upper temperature range with molded specimens is never attained here. In these experiments, when all curves had gone off scale, indicating considerable elongation of all specimens, loads were reduced. When this was done shrinkage, followed by stretch, occurred.

In Fig. 5, p. 174, the heat-distortion behavior of injection molded polyvinyl chloride, with and without plasticizer, is depicted. Two of the curves were determined using material containing 10 parts of dioctyl phthalate, at 4 and 8 p.s.i. stress, respectively. This small difference of applied stress was sufficient to overcome almost completely the locked-in molding stresses. Both curves exhibit lower distortion temperatures than one in which the material was unplasticized. A curve was also obtained using a polyvinyl chloride composition

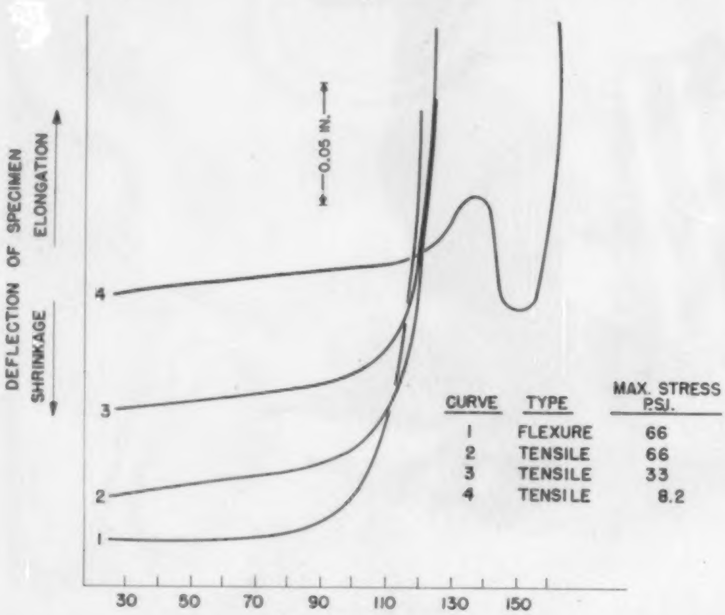


Fig. 6: Heat distortion of injection molded plasticized butyrate

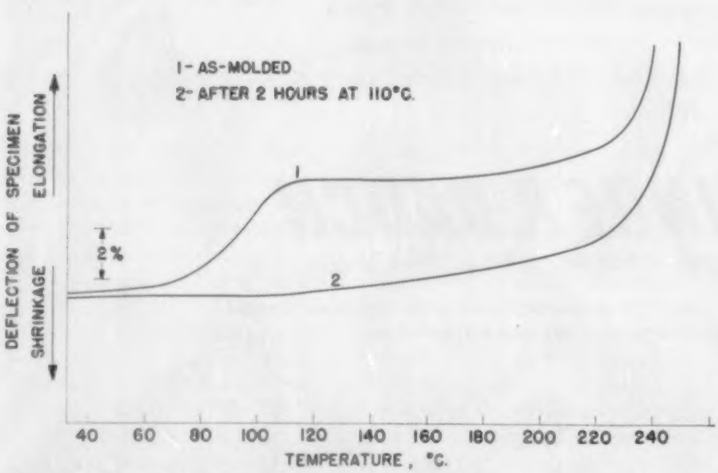


Fig. 7: Flexural heat distortion of injection molded crystallizable plastic, before and after heat treatment

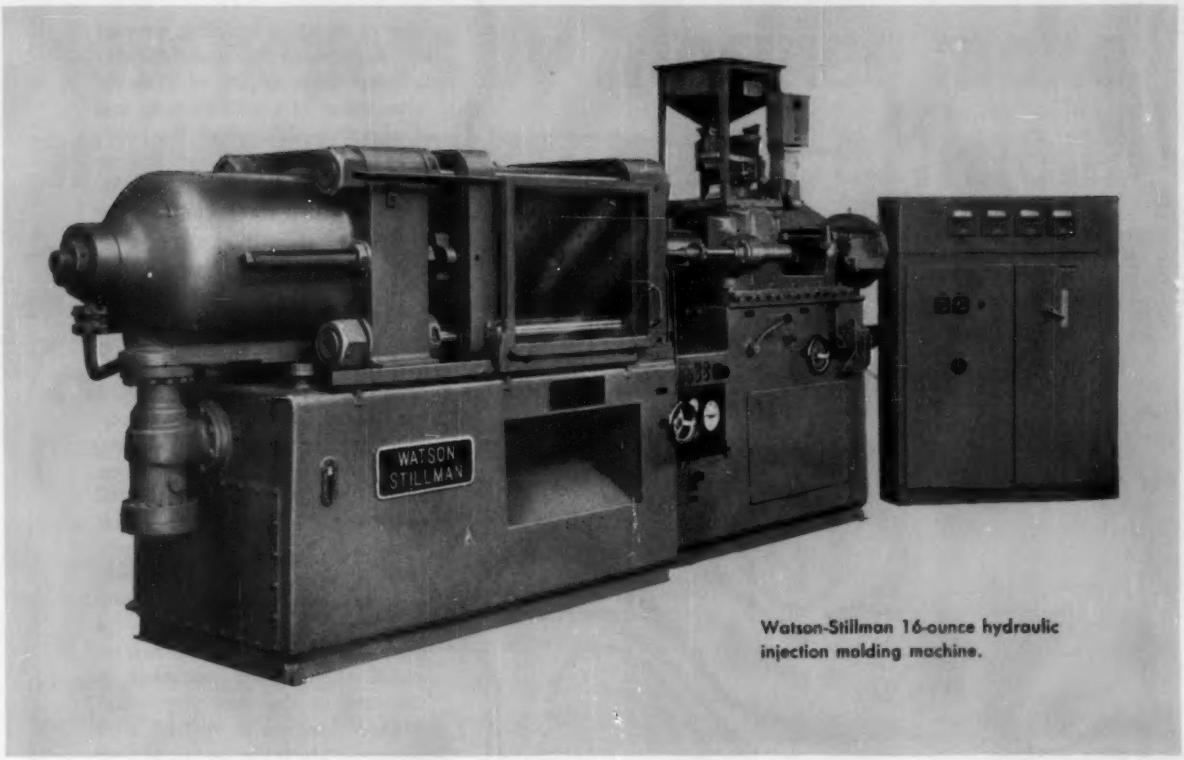
containing 17 parts of dioctyl phthalate. The heat-distortion temperature was lowered considerably by this amount of plasticizer, and an unusual sequence of stretch, shrink, and stretch was obtained at a constant stress of 4 p.s.i.

The heat-distortion behavior of a plasticized cellulose acetate butyrate is shown in Fig. 6, left. Three of the specimens were run in the usual manner, in tension, with applied stresses of 8, 33, and 66 p.s.i., respectively. The fourth specimen was tested in bending, using a bar 3/16 in. thick and ½ in. wide. The load applied to the bending specimen was such that the maximum fiber stress was 66 p.s.i. as is the practice in the A.S.T.M. test. The three specimens tested in tension exhibited the usual behavior except that at the lowest stress, the sequence of stretch, shrink, and stretch was observed. The low-temperature parts of the curves are nearly straight lines and have a slope corresponding approximately with that expected of thermal expansion. As was expected the thermal expansion of the 3/16 in. thickness of the bar in bending was not observable at this magnification.

Figure 7, left, shows heat-distortion curves for injection molded samples of a crystallizable polymer measured as a center-loaded flexural beam at an external load corresponding to a maximum fiber stress of 55 p.s.i. The curve for the as-molded sample first elongates, with a 2% distortion at 82° C., but then at a temperature slightly above 105° C., it levels off as crystallization begins to set in. The curve for a molded specimen that was heat-treated for 2 hrs. at 110° C. shows a very much higher heat-distortion temperature, 203° C. for 2% elongation.

Films and yarn

Figure 8, p. 178, shows effects of orientation and crystallization on melt-extruded films of a crystallizable polymer. An amorphous, unoriented "as-extruded" film specimen under 55 p.s.i. initial stress, curve 1, elongated off scale with a 2% distortion temperature of 93° C. Curve 2 shows behavior



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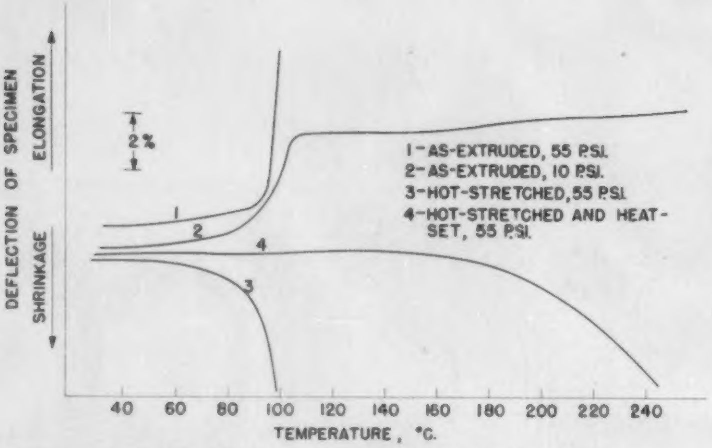

Fig. 8: Heat distortion of extruded films of crystallizable polymer

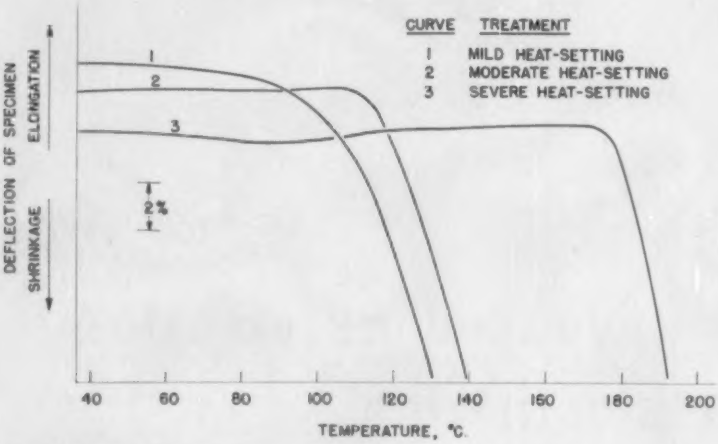

Fig. 9: Heat distortion of yarns

of an as-extruded specimen, of a similar material at a lower stress, 10 p.s.i., to determine the approximate temperature at which crystallization begins. Curve 3 is for a specimen given about a four-to-one stretch at an elevated temperature; initial stress was 55 p.s.i. and total shrink in the heat-distortion test was some 25%, with 2% distortion at 86° C. Curve 4 shows the behavior of a specimen that was given a high-temperature heat treatment to crystallize it after it had been stretched similarly to specimen 3; initial stress was 55 p.s.i.

Figure 9, above, shows heat-distortion curves for specimens of drafted yarns at 55 p.s.i. initial stress. Specimen 1 was given a fairly mild heat-setting treatment, specimen 2 a somewhat more severe treatment, and specimen 3 a 30-min. high-temperature treatment. The 2% distortion temperature increased progressively with increasing severity of heat-setting: 99° C. for specimen 1, 117° C for 2, and 182° C. for 3. By changing magnification to bring the curves back on the chart, it was possible to measure the total shrink. Total shrink decreased in the same order: 70% for 1, 60% for 2, and about 40% for 3.

Discussion and conclusions

The principal virtue of the tensile-distortion test is that it discloses in great detail the dimensional changes that take place over a very wide range of temperature. From this test, conclusions may be drawn concerning not only the resistance to deformation at elevated temperatures but also the quality of molding, ease of injection molding, amount of high-molecular-weight material present, degree of rubberiness, onset of crystallization, and irreversible changes of the polymer. The definition of heat distortion temperature, arbitrary to this test, is equally arbitrary to the A.S.T.M. test.

Contrasting the tests of injection-molded polymethyl methacrylate with those of cast polymer, it is clear that the particular conditions of molding led to considerable internal stress which presumably was caused by a non-equilibrium average configuration of the polymer chains. It has been shown that annealing reduces the magnitude of this shrinkage and that well chosen molding conditions may altogether eliminate shrinkage under minimum load. The very high temperature of final stretch and the low rate at which this stretch occurred in the case of the cast polymethyl methacrylate are in contrast with the moderate temperature of final stretch and the high rate at which stretch occurred for the injection-molded material. It has been found that ease of molding is estimated well on the basis of these criteria and that the large molecular-weight range of cast material is associated with the gradual flow at high temperatures. In the curves for the cast polymer (Fig. 4), entirely adequate explanations for the plateau regions are lacking. Since this polymer does not crystallize (3, 6), it may be that two competing processes are responsible: a contraction of the chains which during polymerization were formed in a more or less extended configuration and a flow under the applied stress.

The influence of molecular weight range on the character of the thermal-distortion curves for injection molded polymethyl methacrylate was evaluated. It was found that with a wide range of molecular weight, the temperature range over which shrinkage was observed was relatively large, and that, with lesser amounts of both high- and low-molecular-weight fractions, the region of shrinkage was less. A good injection molding material is

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Plastics Digest*

Abstracts from the world's literature of interest to those who make or use plastics or plastics products. For complete articles, send requests direct to publishers. List of addresses is at the end of Plastics Digest.

Materials

Wraps off polypropylene. Chem. Eng. News *34,* 2980 (June 18, 1956). The synthesis and properties of polypropylene are described. This polymer has a melting point of about 320° F. and is resistant to solvents.

Silicones step lively. Chem. Eng. News *34,* 2798 (June 4, 1956). A new vinyl curing system for silicone polymers is described. This broadens the scope of properties which are now available in the silicones.

Epoxy adhesives at elevated temperatures. E. W. McGuiness. Materials & Methods *43,* 120-22 (Mar. 1956). The effects which are produced by catalysts, cure temperature, and aging on the properties of epoxy-resin adhesives are discussed.

Poly-α, β, β-trifluorostyrene. D. I. Livingston, P. M. Kamath, and R. S. Corley. J. Polymer Sci. *20,* 485-90 (June 1956). An improved preparation and handling procedure for α, β, β-trifluorostyrene is described. The polymer was prepared best by emulsion polymerization, although anionic polymerization was also found to be operable. A number of properties of the polymer are described, including solubility, the infra-red absorption spectrum, X-ray diffusion (amorphous scattering), dielectric constant (2.56 $\pm$ 0.05), and dielectric loss tangent (0.0006 to 0.0035 over the range 10^2 to 10^{11} c.p.s.). Copolymerization with trifluorochloroethylene gave a copolymer containing 0.096 mole fraction of trifluorochloroethylene, and with styrene a copolymer containing 0.397 mole fraction. The copolymerization curve as well as the constants for copolymerization with styrene are presented and discussed.

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Molding and Fabricating

Large diameter nylon pipe for export. Rubber and Plastics Age *37,* 376-78 (June 1956). The manufacture of nylon pipe of large diameters is described.

Stretching large-area acrylic sheets. A. Batzdorff. Plastics Tech *2,* 463-65 (July 1956). An experimental machine for stretching large acrylic sheets is described.

Calendering equipment for plastics. R. C. Seanor. Plastics Tech. *2,* 448-51 (July 1956). The general construction, operation, and types of calenders are reviewed.

Applications

Teflon and nylon bearing materials. A. J. Cheney, W. B. Happoldt, and K. G. Swayne. Materials & Methods *43,* 100-03 (Mar. 1956). The unique frictional properties of nylon and of Teflon have led to their extensive use in industrial and consumer bearing applications. Heretofore, there has been no successful correlation of operational and test data that clearly indicates when to use which material for a specific application. Recent data on nylon and Teflon used in bearing applications under a variety of service conditions is reported which provides a guide for the selection of these materials and puts bearing design on a firmer basis.

Plastic-bound magnets. G. Hennig. Prod. Eng. *27,* 182-8 (Apr. 1956). The physical and magnetic characteristics of plastic-bound magnets are described and their advantages and limitations discussed. The properties of cast Alnico and plastic-bound Alnico magnets are compared. Typical applications are given, including injection-molded meter magnets, magnets of complex shape, and multipole magnets.

Pressure sensitive tapes. H. R. Clauser. Materials & Methods *43,* 123-38 (Mar. 1956). The field of pressure-sensitive tapes is comprehensively reviewed. Included are paper-backed tapes, cloth-backed tapes, synthetic film tapes, laminated reinforced tapes, specialty tapes, and electrical-grade tapes. Their construction and applications are discussed. Commercial sources of supply are given. The text is supplemented with numerous photographs illustrating applications for pressure-sensitive tapes.

Bonding of Terylene polyester fiber to natural and synthetic polymers. T. J. Meyrick. Rubber & Plastics Age *37,* 394-95, 397 (June 1956). Methods for bonding polyester fiber to other polymers, particularly rubbers, are discussed. Formulas for the adhesives are given.

Superfine thermoplastic fibers. V. A. Wente. Ind. Eng. Chem. *48,* 1342-46 (Aug. 1956). The hot melt method of producing fine thermoplastic fibers may readily be applied to those polymers that possess reasonably low melt viscosities. Fiber diameters less than 1 micron and as low as 0.1 micron are obtainable from such fiber-forming materials as the linear polyamides and polyesters. Although not normally considered fiber-forming, such materials as polystyrene, poly(methyl methacrylate), and polytrifluorochloroethylene also yield submicron diameters. Mats or sheets with random fiber orientation may be collected directly from the heated air stream used to attenuate the fibers. Such mats serve as excellent filter media for fine aerosols and also have potential application as liquid filters. Filters made from special organic materials such as polytrifluorochloroethylene would have unusual resistance to thermal and chemical

degradation. As the fibers are made finer the sheets grow stronger and become more efficient filters. Sheets may be strengthened by densification or addition of binders, but a maximum strength usually exists at the point where an accompanying loss of filtration efficiency reaches its allowable limit.

Coatings

Mechanism of wash primer action. J. Kruger and M. C. Bloom. Ind. Eng. Chem. *48,* 1354-60 (Aug. 1956). Information was obtained on the structure of wash primer film WP-1, the mechanism of its formation, and its mode of action in retarding corrosion and enhancing paint adhesion on iron surfaces. X-ray and electron diffraction, electron and optical microscopy, infra-red spectroscopy, and paramagnetic resonance techniques were used. An iron surface coated with wash primer generates a protective oxide film, supplies chromate for repair of any damage to such a film, supplies a zinc phosphate film analogous to the film produced in phosphate treatment, and superimposes on these an organic film which acts as a good mechanical protection and a bond for subsequent paint films. A tentative picture of the mechanism of wash primer action is developed from these data.

Cellulose lacquers. Ind. Eng. Chem. *48,* 1320-29 (August 1956). Ten short articles on specific developments in cellulose lacquer technology are presented.

Properties

Investigation of the dynamic mechanical properties of polymethyl methacrylate. B. Maxwell. J. Polymer Sci. *20,* 551-56 (June 1956). The dynamic mechanical properties of polymethyl methacrylate were studied over a frequency range of from 6×10^{-4} to 1.6×10^{2} cycles per second and a temperature range of from -20 to 80° C. To cover this frequency range with a single piece of apparatus, a modified Kimball-type testing machine was developed. The testing method is analyzed and the data taken on

(*To page* 186)

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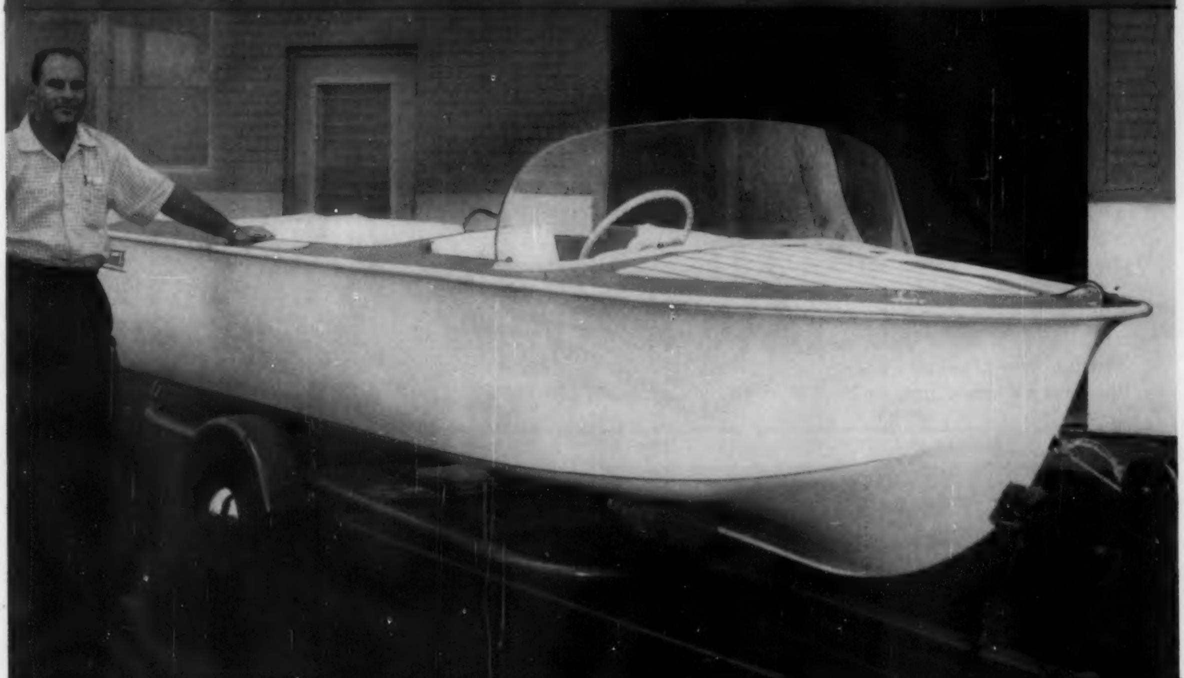
polymethyl methacrylate and other plastics interpreted in terms of molecular theory. The results on polymethyl methacrylate indicate that three mechanisms of relaxation are involved in the response of the material in this frequency and temperature range. The importance of dynamic mechanical properties to the practical engineering design of plastics components is discussed. It is suggested that three-dimensional plots of modulus or loss factor versus frequency and temperature is the best method of describing the mechanical behavior of plastics at their use conditions.

Stress relaxation studies of the viscoelastic properties of polymers. A. V. Tobolsky. J. Applied Phys. 27, 673-85 (July 1956). Extensive studies of the viscoelastic properties of polymers undertaken in the author's laboratory by means of the method of stress relaxation are reviewed. The discussion is divided into four parts: chemical stress relaxation, stress relaxation in amorphous polymers, stress relaxation in crystalline polymers, and stress relaxation in certain natural polymers and polyelectrolytes. Mathematical description of the phenomena are presented in simple form. The relations between structure and viscoelastic properties of polymers are discussed. A rather complete overall picture of these phenomena seems to be emerging.

Weathering of ethylcellulose plastic. M. Chamberlain, R. A. DeLap, and C. L. Stacy. Ind. Eng. Chem. *48*, 1209-11 (July 1956). Commercial ethylcellulose was incorporated in typical plastic formulations to study relative contributions of photo-oxidation, thermal oxidation, hydrolysis, and photolysis to degradation. Photo-oxidation accounted for 95% of the chains broken, but there was little tendency for chain rupture by hydrolysis and oxidation in the absence of light under temperature conditions approaching 60° C. Hydroquinone monobenzyl ether was effective in retarding photo-oxidation, but not enough to prevent appreciable degradation during exposure;



bis(2-ethyl-hexyl)phthalate and x,x-bis(1,1,3,3-tetramethylbutylphenyl)ether were used as plasticizers, but no apparent difference on the extent of degradation was noted for these two.

Oxidative degradation of polyethylene. H. C. Beachell and S. P. Nemphos. J. Polymer Sci. *21,* 113-24 (July 1956). The degradation of polyethylene in molecular oxygen between 150 and 250° C., in ozone-enriched O_2 between 20 and 109° C., and in fuming HNO_3 between 25 and 83° C. was studied. The solid, liquid, and vapor products were analyzed by means of their infra-red spectra. Kinetically, the O_2 oxidation reaction appears to be second order. The Elovich chemisorption equation was applied to the data and yielded comparable results. The kinetics were followed by pressure change and constant pressure measurements of oxygen uptake, and by the rate of increase of carbonyl bands in the infra-red spectra. The activation energy of the process was found to be 8-9 kcal./mole for the volumetric and manometric studies as well as for the ozone-catalyzed reaction, while the HNO_3 oxidation gave a 35.6-kcal. value.

Fracture in the extrusion of amorphous polymers through capillaries. J. P. Tordella. J. Applied Phys. *27,* 454-58 (May 1956). In the extrusion of an amorphous, noncross-linked polymer through a capillary, there is a critical stress at and beyond which the emerging stream becomes irregular in shape. This effect appears to originate in the approach to the capillary rather than within the capillary. Tearing or fracture of the molten polymer appears to occur in this region.

Testing

Colorimetric determination of bisphenol-type epoxy resins and their fatty acid esters. M. H. Swann and G. G. Esposito. Analytical Chem. *28,* 1006-07 (June 1956). No quantitative method is available for measuring epoxy resins that is not affected by curing or ester formation with fatty or rosin acids. A modified Marquis reagent develops with bisphenol-type epoxy resins a blue color which is specific and can be used to obtain quantitative measurement of the resins in their unmodified form, in esters, and in silicone blends. The color is due to the etherified bisphenol grouping independent of molecular weight of the polymer. Epoxy resins can be measured in coating uses in solution or in dried films.

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Industrial and Engineering Chemistry: American Chemical Society, 1115 Sixteenth St., N.W. Washington 6, D.C.

Journal of Applied Physics: American Institute of Physics, 57 E. 55th St., New York 22, N.Y.

Journal of Polymer Science: Interscience Publishers, Inc., 250 Fifth Ave., New York 1, N.Y.

Materials and Methods: Reinhold Publishing Corp., 430 Park Ave., New York 22, N.Y.

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Resin. C. E. Parks and G. B. Jennings (to B. F. Goodrich). U. S. 2,753,322, July 3. Vinyl polymer adapted for vacuum forming.

Resins. A. G. Farnham (to Carbide and Carbon). U. S. 2,753,323, July 3. Epoxy resin compositions.

Resins. F. W. Banes, J. F. Nelson, and S. B. Mirviss (to Esso). U. S. 2,753,325, July 3. Soluble hydrocarbon resins.

Copolymer. W. S. Barnhart (to M. W. Kellogg). U. S. 2,753,328, July 3. Copolymer of trifluorochloroethylene.

Polymerization. A. E. Kroll and D. A. Nelson (to Du Pont). U. S. 2,753,329, July 3. Polymerization of tetrafluoroethylene.

Cellulose esters. E. D. Klug (to Hercules). U. S. 2,753,337, July 3. Sulfuric acid esters of cellulose.

Extrusion. F. Dulmage (to Dow). U. S. 2,753,595, July 10. Plastic mixing and extrusion.

Resin. M. W. Hall (to Minnesota Mining). U. S. 2,754,279, July 10. Glycidyl polyethers of dihydric phenols.

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Plastic. W. N. Stoops and B. B. Price (to Carbide and Carbon). U. S. 2,754,282, July 10. Styrene resin plasticized with butadiene.

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Polymerization. R. H. M. Meyer (to Shell). U. S. 2,754,289, July 10. Polymerization process.

Polymerization. R. J. Kern (to Monsanto). U. S. 2,754,290, July 10. Polymerization of acrylic monomers.

Molding. G. E. Henning and E. W. Weitzel (to Western Electric) U. S. 2,754,542, July 17. Advancing and milling plastic material.

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Printing. J. Williams. U. S. 2,754,-606, July 17. Molded printing negatives.

Soil treatment. D. T. Mowry and R. M. Hedrick (to Monsanto). U. S. 2,754,623, July 17. Soil treated with an acrylic polymer.

Molded laminates. R. S. French (to Keyes Fibre). U. S. 2,754,730, July 17. Molded fibre-resin article.

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Plasticizer. M. H. Dilke, D. Faulkner and S. Merry (to Distillers). U. S. 2,755,259, 1-62, July 17. Plasticized vinyl polymer.

Coating. E. K. Stilbert, Jr. I. J. Cummings and J. P. Talley (to Dow). U. S. 2,755,260, July 17. Fire-retardant vinyl halide compositions.

Adhesives. H. Schenermann (to Badische Anilin). U. S. 2,755,263, July 17. Urea adhesives.

Plasticizer. W. L. Riedeman (to Rohm and Haas). U. S. 2,755,264-5, July 17. Plastics containing carbonate nitriles and amides.

Solutions. W. Brenschede (to Farbenfabriken Baeyer). U. S. 2,755,266, July 17. Solutions of elastomers derived from isocyanate modified polyesters.

Polymers. R. W. Finholt (to General Electric). U. S. 2,755,267, July 17. Polymeric chlorotrifloroethylene.

Resins. H. Uelzmann (to Badische Anilin). U. S. 2,755,268, July 17. Resinous condensates of acetoacetic esters and unsaturated aldehydes.

Resins. K. W. Moorhead (to Dow Corning). U. S. 2,755,269, July 17. Phenol-aldehyde organosilicon resins.

Resins. R. A. Hayes (to Firestone). U. S. 2,755,270, July 17. Compositions of polystyrene, butadiene rubber, and graff copolymers.

Resin. P. O. Tawney and R. H. Snyder (to U. S. Rubber). U. S. 2,755,271, July 17. Hard compositions of neoprene and polyvinyl chloride.

Polyesters. L. H. Bock (to Rayonier). U. S. 2,755,273, July 17. Polyesters from hydroxyalkyl ethers of vanillic acid.

Coating. R. M. Heller. U. S. 2,755,-507, July 24. Applying plastic coatings.

Mold. M. Maccaferri. U. S. 2,755,508, July 24. Mold apparatus.

Molding. L. Smidth (to American Viscose). U. S. 2,755, 509, July 24. Producing molding powder.

Splints. P. Brandan (to Union Broach). U. S. 2,755,552, July 24. Plastic dental jaw splint.

Shoe. R. L. Rudine. U. S. 2,755,567, July 24. Plastic clogs.

Tube. W. F. Stahl. U. S. 2,755,821, July 24. Laminated tube.

Coating. C. E. Herrick, Jr. and W. F. Amon, Jr. (to General Aniline). U. S. 2,756,163, July 24. Moisture-sensitive coating.

Laminate. F. L. Thomas (to

Bjorksten Research). U. S. 2,756,171, July 24. Safety glass laminate.

Cover. A. C. Kidd. U. S. 2,756,172, July 24. Vinyl tape for covering pipe insulation.

Plastic. J. B. Eisen. P. R. Giradot, E. G. Paquette, and S. E. Rohowetz (to Bjorksten Research). U. S. 2,756,-173, July 24. Electrically conductive plastic.

Panels. R. H. H. Siu. U. S. 2,756,174, July 24. Forming filamentous panels.

Ion exchange. J. T. Clarke (to Ionics). U. S. 2,756,202, July 24. Condensation polymers of sulfonated alkylaryl ethers.

Solutions. G. E. Ham (to Chemstrand). U. S. 2,756,218, July 24. Solutions of polyacrylonitrile.

Copolymers. F. J. F. Vander Plas and C. P. van Dijk (to Shell). U. S. 2,756,219, July 24. Plasticized vinyl halide plastic.

Polyamides. J. R. Caldwell (to Eastman Kodak). U. S. 2,756,221, July 24. Linear polyamides.

Vinyl resins. D. Swern and W. S. Port (to United States). U. S. 2,756,-222, July 24. Purification of long chain vinyl resins.

Plastic sheet. P. Kellner. U. S. 2,756,459, July 31. Machine for use in forming a variety of plastic sheets.

Extrusion. E. M. Hadley, Jr. (to Castings). U. S. 2,756,451, July 31. Plastics extrusion.

Molding. W. H. Smith. U. S. 2,756,-480, July 31. Presses for molding plastics.

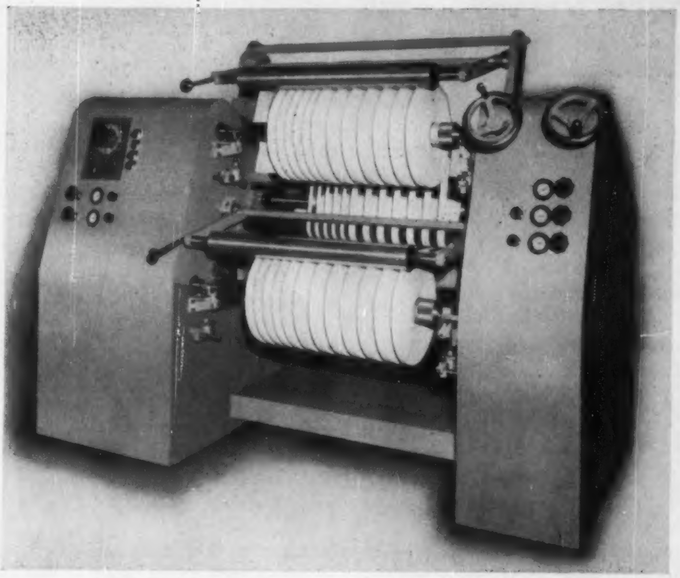
Paper treating. E. E. Morse (to Brown). U. S. 2,757,086, July 31. Wet strengthening paper by means of urea resins.

Coated paper. G. L. Brown and B. B. Kine (to Rohm and Haas). U. S. 2,757,106, July 31. Paper coated with acrylic resin.

Directory correction

Irvin, Jewell & Vinson Co., Dayton, Ohio, was incorrectly listed under the classification "Chemicals" on p. 998 of the Directory Section of the 1956 MODERN PLASTICS Encyclopedia issue. The company is a manufacturer of acrylic lacquers and oil base coatings and should be classified under "Coatings" on p. 999 of the Directory.

TIME PROVED FOR VERSATILITY . . . DUSENBERY



Slitter

AND

Rewinder

MODEL 635

for FILM, FOIL, TAPE, PAPER

- SHEAR CUT
- RAZOR BLADE
- BURST CUT
- SCORE CUT *

SPECIFICATIONS:

MODEL 635
WIDTH . . . THROUGH 62″
REWINDS AVAILABLE FOR 1″ THROUGH 6″ I.D. CORES

MINIMUM SLIT WIDTH ¼″

WEB SPEEDS TO 1,200 FPM
(Depends on machine widths, slit materials and drive)

MODEL 635 AB
REWIND 13½″ UNWIND 18″

MODELS 635 AF and BF
REWIND 18″

MODELS 635 AH and BH
REWIND 24″

All machines can be supplied with our Model 704 Unwind Stand, featuring precise web guiding and air operated tension controls for diameters through 42″

Write for Bulletin 704

In slitting plastic film, laminated foil, tape, glass cloth and paper, the Model 635 utilizes the latest developments and has thoroughly proved its worth in production. The differential rewind reduces rejects, resulting in more economical production. Although designed for large scale production, the Model 635 is so versatile that in many cases it has been placed in engineering departments, laboratories and pilot plants for slitting and rewinding new materials on small production runs.

This machine can be supplied as shear cut, razor blade, burst cut or score cut*. Change over from shear cut to razor blade or to burst takes only a matter of minutes, giving complete versatility of slitting methods for handling a wide range of materials.

Highly sensitive air operated tension controls on the unwind and rewind can be adjusted while machine is running or stationary. Once the optimum running conditions for a given material are determined, repeat settings may be made without guess work. Because of these sensitive controls, an unskilled operator can readily be taught to operate this machine.

MANUFACTURERS OF:
SLITTERS, WINDERS, CONSTANT TENSION UNWINDERS, KNIVES, LEVERS, SLEEVES.

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SPECIAL CONVERTING EQUIPMENT DESIGNED TO MEET YOUR PRODUCTION PROBLEMS

**On special applications score cut can be provided*

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CONVERTING EQUIPMENT

JOHN DUSENBERY CO., INC., 274 GROVE AVE., VERONA, N. J. Tel: CEnter 9-3900

New Machinery and Equipment*

Tensile and compressive tester

The Model CET is said to combine features of flexibility and precision not heretofore available on any tester and to make it possible to test, on one machine, a wide range of materials. It is designed to test tensile, hysteresis, and compression properties within a load range of 0 to 2000 lb. and a rate-of-elongation range of 0 to 40 in./minute. Maximum stroke is 72 inches. The electric weighing system has an accuracy of 0.25 percent. The controls are designed so that a selected portion of the stress-strain curve can be isolated and shown full-span on the chart, greatly magnified. Compression specimens up to 15 in. square by 20 in. high can be tested. Hysteresis testing can be accomplished either manually or automatically. *Scott Testers, Inc., 96 Blackstone St., Providence, R. I.*

Foam-making machine

A greatly simplified machine for making both rigid and flexible polyurethane foams is designed so that the flow of the two components is easily regulated to give the foam with the desired properties. The components are fed to the pumps from over-head tanks. Variable-speed drives power the positive-displacement pumps to give accurate proportioning of the components before they enter the mixing head. With the mixing, CO_2 is evolved causing controlled foaming of the resin. No mechanical whipping is needed, rather, the product can be immediately fed into molds. Extension lines on the discharge permit foaming-in-place operations. Any density between 2 and 20 lb./cu. ft. can be obtained, leading to a wide variety of properties. *Klauder Williams Co., Adams Ave. and Leiper St., Philadelphia, Pa.*

Automatic compression presses

The Model 400-150 press, said to be the first automatic 150-ton press, automatically performs such operations as feeding, degassing, ejection, and flash clean-out. It also features a wide range of closing speeds—from 6.1 to 355 in./min.—with automatic deceleration and a safety device that stops the press if it encounters an obstacle during closing. An emergency button returns the press to the top of its stroke from any point in the cycle.

Independently operating upper and lower hydraulic ejection is standard on the press, as is the Baker Universal Loading Board and automatic metering device. The loader makes it possible to feed as many as forty cavities per cycle; several tubes may be directed to feed into a single cavity, or may be shut off completely, as desired. The number of cavities fed can be changed in a few minutes, so very little extra set-up time is needed to adjust the feeder when molds are changed. The loading board is equipped with a vibrator that insures complete emptying of loading cups.

The stroke of the press is 15 in., and its daylight opening is 30 inches. The ram can be regulated to deliver any force between 14 and 150 tons, with a top working hydraulic pressure of 3300 p.s.i. The press has a 10-hp. motor and is ready to operate as soon as it is hooked up to a 220-v. line, an 80-p.s.i. air supply, and a water supply that will furnish 3 g.p.m. of cooling water for the hydraulic system. A 60-ton press of similar design is also being offered now. *Baker Brothers, Inc., P.O. Box 101-Station F, Toledo 10, Ohio.*

Baker Bros. Model 400-150 compression press feeds, degasses, ejects, and cleans out flash automatically

Prints plastic pipe

The Markem Model 15AE roll printer continuously marks pipe made of polyethylene, vinyl, etc., with company name, trademark, or other information. In a typical installation, the 15AE is mounted on the extruding equipment and draws its power from the wind-up. It may also be separately driven. Imprint is made by precisely molded rubber printing elements, sponge-backed and mounted on curved steel plates. Printing elements can be exchanged quickly to meet new requirements. The maximum imprint area is 24 by 1.75 in., with repetition of imprint at intervals of 24 in. or less. Operating speed is governed by extrusion speed. Over-all dimensions are 12.5 by 18.7 by 7.7 inches. *Markem Machine Co., Keene 60, N. H.*

High-watt-density heaters

Thunderbolt cartridge heaters are built so that the insulated resistance elements are close to the inside surface of the sheath. The resulting high rate of heat transfer makes it possible to operate these heaters at much higher sheath temperatures with no increase in the temperature of the resistance wire. Ratings between 40 and 200 watts/(sq. in. of sheath surface) are available. They are

*Specifications and claims made and appearing in these pages are those of the manufacturers of the machinery and equipment described and are not guaranteed by MODERN PLASTICS.

MODEL
H-250

Step Up Production with VAN DORN 2½ Oz. Automatic Press

Check these outstanding features of this ultra-modern Van Dorn injection press:—

GREATER CAPACITY— Up to 2½ oz.; smaller pieces at faster cycles.

HI-SPEED PERFORMANCE— Plasticizes material at 22 lbs. plus per hour.

FASTER PRODUCTION—Will attain up to 720 cycles per hour (dry run).

HIGHEST EFFICIENCY—Due to water cooling of injection plunger, transfer hopper and oil cooler.

ACCESSIBILITY— Due to simple platen clamp device for purging to change material or color.

MORE SAFETY—Mold hydraulic mechanism makes press non-operative unless molded part is completely ejected.

SIMPLER OPERATION—Due to automatic, adjustable material metering device.

MULTIPLE OPERATIONS—Minimum operator attention by use of larger hopper and light that indicates when press needs attention.

SELECTIVE CONTROL—Merely throw toggle switch to operate press semi-automatically.

DEPENDABILITY— Because of all-steel construction and Van Dorn's established reputation in the plastics machinery field.

THE VAN DORN IRON WORKS CO.
2687 East 79th Street • Cleveland 4, Ohio
Cable Address: "VANDORN" Cleveland

and this Van Dorn model is the lowest priced press in its class!

Write for complete data on Model H-250 and other equipment shown. FINANCING AVAILABLE

SEMI-AUTOMATIC PRESS
2-oz. capacity.

POWER OPERATED, LEVER CONTROLLED PRESSES
2-oz. and 1-oz. models

PLASTIC GRINDER
Grinds up rejects, waste, etc., for re-use.

MOLD BASES
Available from stock.

available in diameters of 3/8, 1/2 and 5/8 in., and sheath lengths from 1.25 to 10 inches. Also designed for long life, the standard 10-in. lead wires consist of 2-in. sections of solid nickel alloy wire insulated with fibrous glass, and 8-in. sections of stranded nickel alloy wire, Glasbestos insulated. *Vulcan Electric Co., 85 Holten St., Danvers, Mass.*

8-oz. injection machine with preplasticator shoots 22 ounces

Featuring a radically different preplasticator mechanism, the Lewis Model 616-PP-12 is the first production machine used to mold the low-pressure linear-type polyethylenes. The new preplasticator, which was designed particularly for this 8-oz. machine, raises its shot capacity to 22 ounces. It has a nozzle shut-off valve that does away with the need for holding pressure on the ram after injection (unless the mold is to be packed). The machine offers the many advantages of more even temperature, less thermal hazard, faster injection, less danger of flash, etc., that are characteristic of operation with a preplasticator (see "Preplasticators pay off on small shots, too" on p. 143 of this issue). Because of the low differential between the temperatures of cylinder wall and melt, the cycle can be interrupted for long periods, if necessary, without danger of burning the plastic.

The machine dry cycles in 10 sec., has a plasticating capacity of 145 lb./hr., can attain the unusually high injection pressure of 25,000 p.s.i., and has a top clamping force of 200 tons. Operators will often be able to take advantage of the high available melt pressure, which is completely transmitted to the nozzle, to force a greater weight of melt into the mold cavities, thus reducing shrinkage.

Maximum injection rate is 9.2 cu. in./sec., maximum clamping stroke is 12 inches. Molds may be as large as 14.7 in. sq., with thicknesses ranging from 6 to 16 inches. The hydraulic system is driven by a 25-hp. motor. *Lewis Welding and Eng. Corp., 23002 St. Clair Ave., Cleveland 17, Ohio.*

Combination marker, coater

A new sheet marker continuously prints sheet plastics or metals with symbols, trademarks, descriptions, etc. Laminate coatings can also be applied with this machine, using precision rollers to meter hot melts or solutions. The standard machine handles sheets ranging from 25 to 250 mils thick, from 14 to 24 in. wide, and from 34 to 42 in. long. The printing area is 13 in. wide and is adaptable to different lengths. Printing speeds range up to 2800 sheets per hr., depending on sheet size and operator proficiency. The feeder conveyor is built to prevent scratching or other marring of sheet surfaces. *Industrial Marking Equipment Co., 454 Baltic St., Brooklyn 17, N. Y.*

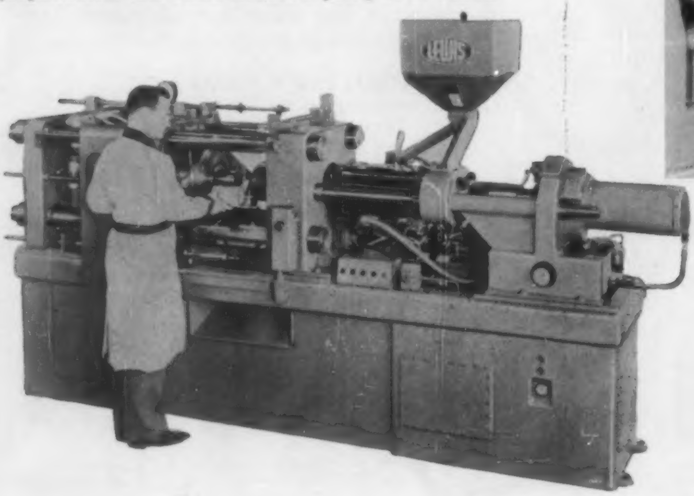
Fast-demounting press rolls

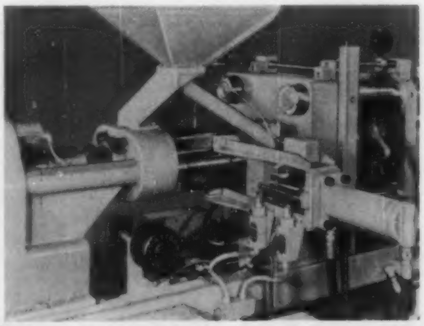
Micro-lok cylinders for printing presses are "the fastest operating demountables ever offered," and are made to retain extreme accuracy and very close concentricity through years of service. They can be mounted in seconds without heating or fitting, and are positively locked into position with a quick turn of a spanner wrench. These cylinders are available in lightweight alloys or in steel. The locking parts are integral with the cylinder and will fit shafts of any diameter. *Paper Machinery and Research Co., Inc., 1014 Oak St., Roselle, N. J.*

Desk-type heat sealer

A heat sealer that closely resembles an office desk combines a dielectric heating generator with a clam-type press. Pieces to be

Lewis Welding & Engineering Model 616-PP-12 8-oz. injection machine, the first production machine for molding linear polyethylene, incorporates special preplasticator that raises its shot capacity to 22 ounces





Close-up of preplasticator installed on Lewis Model 616-PP-12. This machine also has a nozzle shut-off valve that eliminates need to hold pressure on ram after injection

Erdco Engineering desk-type heat sealer combines dielectric heating generator with a clamp-type press

processed are positioned on the desk top and the operator, seated behind the desk, presses two buttons to start the sealer through an automatically timed cycle. Areas up to 12 sq. in. and straight seals as long as 20 in. (45 in. on special order) may be sealed in one cycle. The rated output may be either 2 or 3 kw.; actual power output is adjustable to any value up to the limit. Curved seals are easily made. When the clam-type press is open it leaves over 7 in. of working clearance. The RF generators of these sealers are available for the 27-mc. or the 40-mc. band and are equipped with line filters. The desk sealer will be furnished with shielding that meets FCC regulations if it is desired. *Erdco Engineering Corp., Addison, Ill.*

Belgian injection machine

The Smal S60 is rated at 2.2 oz. of polystyrene per shot, with a plasticating capacity of 26 lb./hr. Its top injection pressure is 16,800 p.s.i. and it has a high clamping force of 80 tons, allowing a large projected area. Maximum daylight is 20.2 inches. Molds to 18.1 in. wide by 8.6 in. high by 12.2 in. thick (or 3.2 in. thin) can be accommodated. The mold closing mechanism is designed for high speed, and the machine dry-cycles in 7.2 seconds. It is driven by an 8-hp. motor and uses about 4.7 kw. of heating power. The motor and control timers are designed for 50-cycle, 220-v. a.c. in the standard model—American purchasers will want to specify 60-cycle equipment. The machine comes equipped with a "compensating" feeder.

The maker also produces a larger machine, the Model S250-350, that will shoot 9 oz. per cycle (or 12.6 oz. with a double stroke), with a plasticating rate of 55 lb./hr. and a dry-cycle time of about 15 seconds. Top injection pressure is 18,400 p.s.i., top clamping force is 275 tons. *Smal & Co., S.A., 103 rue Bara, Brussels, Belgium.*

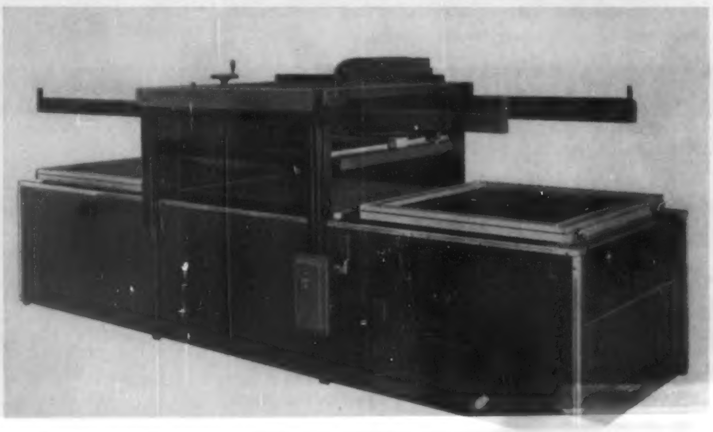
Sheet thermoforming machine

The Model 40-A Pak-O-Vac, the largest of the line, is a vacuum- and drape-forming machine especially adaptable to packaging applications. Completely automatic, the 40-A features two work stations that allow loading and unloading to go on without interrupting production. Either or both stations may be used, as desired. Sheets up to about 30 in. square may be handled in frames that are easily adjusted to the desired depth of draw. Air and vacuum controls permit handling a wide range of sheet materials and gages without danger of spoilage because of excess heat or speed of draw. Oven cycling is completely automatic. The 40-A is about 12 ft. long by 3.5 ft. wide, weighs 1800 pounds. *Product Packaging Engineering, 5747 Marilyn Ave., Culver City, Calif.*

Automatic metering and degassing equipment for reactive mixes

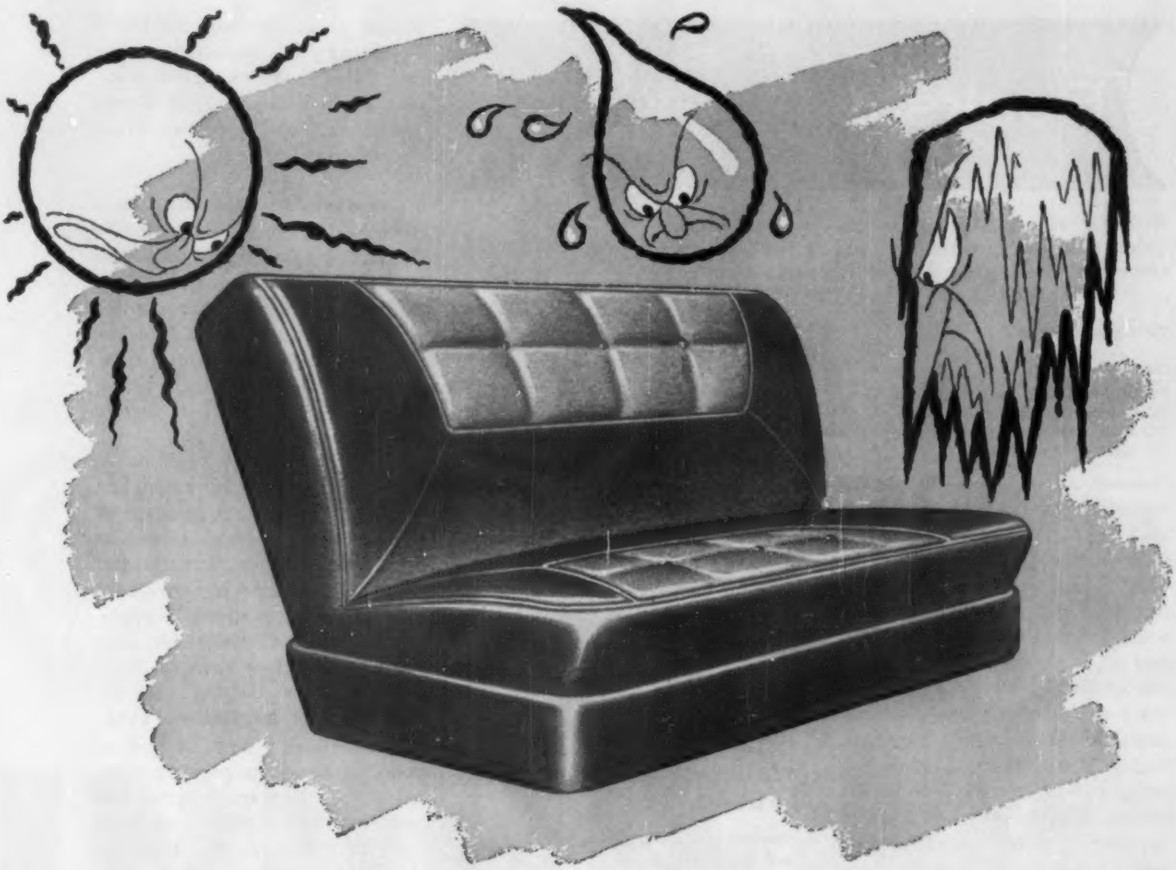
Several different designs of equipment for the continuous proportional metering of resins (including abrasive fillers) and hardeners are now available. Viscosities up to 10,000 poises can be handled, over a range of temperatures. The heart of the equipment is a positive-acting hydraulic escapement mechanism with double feed-back control. This gives accuracies better than ±0.5% of any one of several components. It is adjustable over a wide range of component ratios and has successfully handled epoxies, polyesters, polyurethanes, and other resins. The metered streams meet in a mixer-reactor with a volume of only 5 to 10 cc., at capacities up to 4 liters of mix per minute. Discharge pressures up to 3000 p.s.i. can be reached. Operating either continuously or intermittently, the mixer-reactor is kept clean by automatic purging. By sealing the entire system, contaminants are kept out. Individual streams may be de-aerated for vacuum casting. *Applied Engineering Associates. 1952 Flushing Ave., Brooklyn 37, N. Y.*

Product Packaging Engineering Model 40-A Pak-O-Vac is especially designed for sheet thermoforming for packaging applications



Sales Offices in:

and Samples



Books & Booklets

Write for these publications to the companies listed. Unless otherwise specified, they will be sent gratis to executives who request them on business stationery.

"Polyethylene"

By R. A. V. Raff and J. B. Allison

Published in 1956 by
Interscience Publishers, Inc.
250 Fifth Ave., New York, N.Y.
551 pages. Price: $16.00.

Volume XI of "High Polymers" continues to maintain the high standards of the series. Eight of its ten chapters cover the history, polymerization, structure, modification, properties, processing, uses, and testing of polyethylenes, and there is a chapter on ethylene and an interesting statistical summary of production, since 1938, of principal engineering materials. Some 1200 different references include more than 600 from the period 1951-55, and even 57 from early 1956. In the long chapter on polymerization (69 pages) about 21 pages are devoted to depolymerization, degradation, and stabilization. There are 122 tables and 228 figures, mostly graphs, packed with useful data on this important group of polymers. It is, however, almost entirely restricted to polymers of ethylene, with little more than a few mentions of saturated hydrocarbon polymers obtained from other monomers.

"Steric Effects in Organic Chemistry"

Edited by Melvin S. Newman

Published in 1956 by
John Wiley & Sons, Inc.,
440 Fourth Ave., New York, N.Y.
710 pages. Price: $12.50.

The thirteen chapters of this book have been written by ten professors and two researchers, representing 11 widely separated institutions, and may be expected, therefore, to be a representative sampling of current thinking on the subject. The editor writes that ". . . no attempt has been made to include areas which are already well covered in existing treatises or to cover all of the reactions or phenomena in which steric effects have been noted. Rather, only enough data is presented . . . to give the reader sufficient background so that he may interpret other reaction in that area for himself." Each chapter is preceded by an outline of its contents, and each has its own list of references (about 1500 in all). To many workers the long final chapter on the separation of polar, steric, and resonance effects in reactivity will be especially interesting.

"The Condensed Chemical Dictionary"

Revised and enlarged by Arthur and Elizabeth Rose

Published in 1956 by
Reinhold Publishing Corp.,
430 Park Ave., New York, N. Y.
1220 pages. Price: $12.50.

This fifth edition of the well known dictionary has been expanded to over 30,000 entries. In addition to listing and defining the chemicals, the volume gives data on their properties; composition; latest information on containers, shipping regulations, and safety instructions; and new uses of chemicals in nuclear energy, chemotherapy, and other fields of current interest. The thumb-indexed book also includes up-to-date information on tradenames and trademark products.

Extrusion. Methods of extruding acetate and butyrate into sheet, variegated-color strips, pipe, and tubing are described; suggested guides for correcting extrusion problems are covered. 28 pages. *Eastman Chemical Products, Inc., Kingsport, Tenn.*

Sheet forming. Brochure gives specifications, advantages, and general information on a line of plastic sheet forming machines. Operating data, accessory equipment, and photos of typical products are included. 8 pages. *Comet Industries, 9865 Franklin Ave., Franklin Park, Ill.*

Thermocouples. Bulletin No. 5 describes a line of miniature thermocouples designed for use in highly corrosive gases and liquids. Included is a thermocouple for use on extruder head, die, or manifold to obtain accurate temperature measurements. 14 pages. *Thermo Electric Co., Inc., Saddle Brook, N. J.*

Vinyl acetate. Information on physical properties, grades, specifications, and handling, as well as details on polymerization and chemical reactions of vinyl acetate monomer are given. 20 pages. *Air Reduction Chemical Co., Inc., 150 E. 42 St., New York, N. Y.*

Marking and imprinting. Catalog describes a line of coding, marking, and imprinting machines for packages, parts, and products. Ten different machine models are covered. 4 pages. *Adolph Gottscho, Inc., Hillside 5, N. J.*

Fluorocarbon. Forms, properties, and characteristics of a range of fluorocarbon products used in the chemical, electrical, and aviation fields are described. Fluorocarbon products available include molding and extrusion plastics; dispersions and coating resins; oils, waxes, and greases; and printing inks. 8 pages. *M. W. Kellogg Co., P. O. Box 469, Jersey City, N. J.*

Catalog, price list. "Radiochemical Catalog" contains a complete price listing of this firm's carbon-14, tritium, and deuterium compounds. 10 pages. *New England Nuclear Corp., 575 Albany St., Boston, Mass.*

Cellulose wadding. Brochure gives information on the use of cellulose wadding as protective packaging and cushioning. It also covers uses in the bedding and quilting industries for stitched and stitchless sealing to plastics and other facings, in furniture and appliance production, in filtering

applications, etc. Companion brochure covers cellulose wadding used to package equipment for the armed services. *Cel-Fibre Div., Personal Products Corp., Milltown, N. J.*

Vinyl. Two booklets (VC-1, 12 pages, and VC-2, 14-pages) give advantages, limitations, processing information, physical and chemical properties, etc., for a rigid vinyl extrusion compound and a modified rigid polyvinyl chloride calendering compound, respectively. *The General Tire and Rubber Co., Chemical Div., Akron, Ohio.*

Non-woven fabric. Properties, characteristics, and samples of a non-woven fabric made of fibers bonded with resin are given. This material is being used as a reinforcement in high-pressure plastic laminates, as a base for vinyl-coated upholstery and auto trim, and in shoes, handbags, shoulder pads, luggage, etc. 16 pages. *Wellington Sears Co., 65 Worth St., New York, N. Y.*

Inks. Three technical data sheets describe three types of ink in terms of general characteristics, fields of application, and recommendations for proper use. *Bensing Bros. and Deeney, 3301 Hunting Park Ave., Philadelphia, Pa.*

Conveyors. Nineteen different types of power conveyors for handling a variety of items, large or small, are described in Bulletin 303. Dimension data and installaton photos are included. 24 pages. *Harry J. Ferguson Co., Jenkintown, Pa.*

Standards. "How American Standards Are Made" describes three ways in which standards become nationally accepted and approved. It also tells who makes these standards, why, and who uses them. 22 pages. *American Standards Association, 70 E. 45 St., New York, N. Y.*

Propionaldehyde. Physical properties, specifications, shipping data, applications, toxicity, and typical reactions, are given in Bulletin F-40110 for propionaldehyde, a chemical intermediate

used in the manufacture of polyesters and other compounds. It is also used to make pharmaceuticals, rubber accelerators, ion exchange resins, demulsifiers, perfumes, etc. 13 pages. *Carbide and Carbon Chemicals Co., 30 E. 42 St., New York 17, N. Y.*

Variable speed drives. Specifications, characteristics, engineering drawings, principles of operation, and controls for a line of variable speed drives are described in a set of bulletins. *Graham Transmissions Inc., Menomonee Falls, Wisconsin.*

Toolholders. Catalog No. VR-437 describes a line of positive and negative rake toolholders. Dimensions, prices, ordering information, recommendations, etc., are included. 24 pages. *Vascoloy-Ramet Corp., Waukegan, Ill.*

Polyvinyl acetate. Characteristics and properties of polyvinyl acetate emulsions for use in paints are described. Techniques for formulating paints; suggested formulations for exterior, interior, and primer sealer applications; and packing, storage, and handling details are covered. 18 pages. *Shawinigan Resins Corp., Springfield, Mass.*

Silicone rubber. Physical, chemical, and dielectric properties of two general-purpose silicone rubber stocks are presented. In addition, typical applications in the aircraft, automotive, industrial, and domestic appliance fields are covered. 8 pages. *Dow Corning Corp., Midland, Mich.*

Anti-oxidant. Structural formula, specifications, and properties of a new anti-oxidant are presented. Applications covered include gasoline, jet fuels, waxes and oils, as well as protection from oxidation and discoloration for polystyrene, vinyl films, and polyethylene. 8 pages. *Catalin Corp. of America, 1 Park Ave., New York, N. Y.*

Irradiated polyethylene. Properties, characteristics, and roll dimensions of irradiated polyethylene tape for use as insulation by motor repair shops are de-

scribed in brochure CCD-1. 4 pages. *General Electric Co., Chemical Development Dept., 1 Plastics Ave., Pittsfield, Mass.*

Polyester resins. Set of bulletins gives information on the preparation of premix compounds using different grades of polyester resins. Some of the subjects covered include: catalysts, inhibitors, fibrous reinforcements, fillers, mixing, storage, handling, use, etc. *Interchemical Corp., 1754 Dana Ave., Cincinnati, Ohio.*

Chemicals. Twenty-page booklet gives characteristics, grades, uses, and brief descriptions of the complete line of organic, inorganic, and specialty chemicals produced by *Olin Mathieson Chemical Corp., Industrial Chemicals Div., Baltimore 3, Md.*

"How to choose an extruder." This 46-page booklet, though it is intended to promote Prodex extruders, contains a wealth of information which should help any prospective purchaser of an extruder to decide what features are available in extruders, what one he needs, and what design factors will contribute to good performance and low maintenance. No processor who has digested its contents can remain naive about screw extruders. *Prodex Corp., Fords, N. J.*

Rubber reinforcing resins. Technical bulletin describes new reinforcing agents for natural and nitrile rubbers. Properties, characteristics, and numerous charts are included. 28 pages. *British Resin Products Ltd., Devonshire House, Piccadilly, London, W.1, England.*

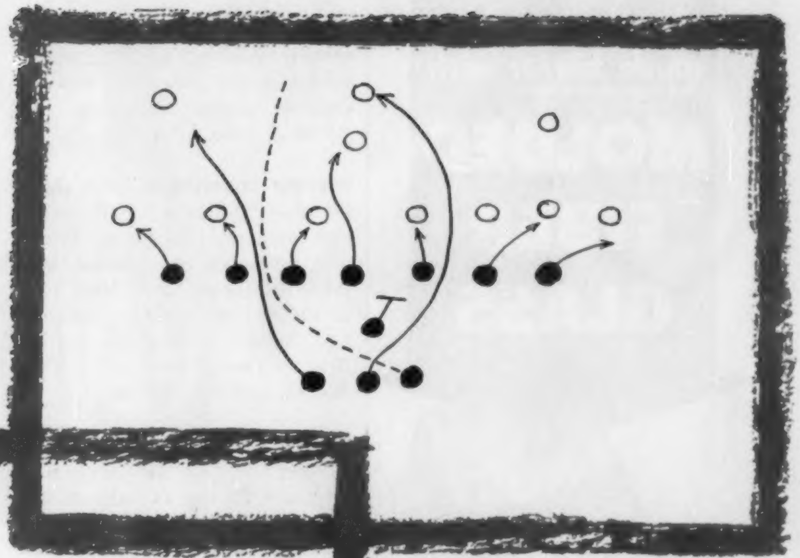
Bonding. Brochure on bondable tetrafluoroethylene products, "Teflon" and "Rulon" (a modified Teflon), discusses method of surface treating the two materials so that they can be adhesive bonded to other plastics, metal, wood, etc. Nature of treated areas, adhesives to be used, dimensions, shapes, sizes, etc., of bondable Teflon and Rulon tape, sheet, rod, tubes, and molded and extruded shapes, and applications are given. 8 pages. Companion booklet reports on introduction of Teflon and Rulon tape in film thicknesses. Data sheet also available describes adhesive W-10 for use with Rulon and Teflon. *Dixon Corp., Bristol, R. I.*

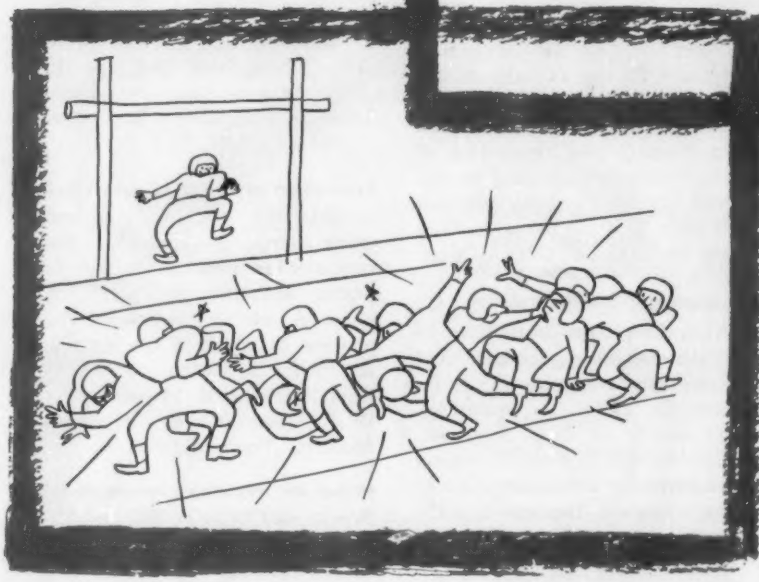
Compacting presses. Complete line of industrial compacting presses, from hand-operated machines of 1½-ton capacity to fully automatic 300-ton hydraulic presses, is described in Catalog 816. 22 pages. *F. J. Stokes Corp., 5500 Tabor Rd., Philadelphia 20, Pa.*

Bonding agents, dry colors. Bulletin 03-1-5-5-56 provides a summary of currently available "Thixon" products for the adhesion of rubber and rubber-like materials to metal, along with an explanation of each designation. Bulletin 02-175-3-7-56 on "Stan-Tone" dry colors that have found acceptance in the vinyl and rubber fields, lists the colors, their

FROM

Design





TO

Delivery

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"Complete" is the word for our plastics custom molding service. If your problem involves plastics, anywhere along the line from idea to finished part or product, call us in. Our experienced designers, engineers, chemists and production people are ready to go to work for you. And completely without bias as to material or method. We work practically all thermoplastic and thermosetting materials — by compression, injection, transfer molding, and vacuum forming. It will pay you to consult Watertown — first!

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trade number, pigment type, specific gravity, and suggested uses. *Harwick Standard Chemical Co., 60 South Seiberling St., Akron 5, Ohio.*

Styrene copolymer. Price sheet for the "Boltaron 6700" series lists standard thickness, thickness tolerance, construction, and prices in quantities of 1000, 1000 to 10,000, and 10,000 or more sq. feet. *Bolta Products, Div. of The General Tire & Rubber Co., P.O. Box 61, Lawrence, Mass.*

Rubber rolls. Booklet defines rubber; tells how rolls are made; discusses density of rubber; details how thick a roll should be; discusses balancing, types, care and feeding, and regrinding of rolls; and factors affecting the nip action of rubber squeeze rolls and roll ends. $2.00. 59 pages. *Rodney Hunt Machine Co., Orange, Mass.*

Anti-static. Folder No. 3 describes how Anti-Static No. 79 destaticizes and prevents dust accumulation on plastics. Anti-Static No. 79-OL for destaticizing fabrics is also described. Folder lists a number of recommendations as to where products should be used. Included is a list of costs. 4 pages. *Merix Chemical Co., 1021 E. 55th St., Chicago 15, Ill.*

Pipe, fittings, and valves. Engineering Memorandum No. 13 deals with rigid unplasticized polyvinyl chloride (PVC) pipe, fittings, and valves. The memorandum discusses such topics as: characteristics of PVC pipe, valves, and fittings; fabrication cost comparisons; sizes and types available; successful applications; dimensions, operating pressures, and weights; and procedures for assembling PVC pipe and fitting by solvent welding method. Included is a corrosion-resistance chart. 15 pages. *Peter A. Frasse & Co., Inc., 17 Grand St., New York 13, N. Y.*

Technical data sheet. Physical properties and uses of such industrial chemicals as alcohols, amines and ammonia, esters, etc., are listed on one side of a technical data sheet; on the other side are listed chemical formulas, physical properties, and uses for nitroparaffins and derivatives. *Industrial Chemicals Dept., 260 Madison Ave., New York 1, N. Y.*

Asbestos. Booklet on asbestos fibers defines the terms "shorts" and "floats" as to classification, composition, and quality; tells how they help improve different products including molded plastics; gives grade recommendations; and includes charts on physical and chemical properties. 12 pages. Booklet on asbestos textiles lists uses and characteristics of asbestos lap, roving, yarn, cloth, tubing, cord, and tape. 16 pages. *Asbestos Fiber Div., Johns Manville Sales Corp., 22 E. 40th St., New York 16, N. Y.*

Education program. Booklet describes the scholarships and grants made available by the company as part of its aid to higher education program. The purposes of the program, the manner in which it is operated, and who is eligible to benefit from it are listed. 14 pages. *The B. F. Goodrich Co., 500 South Main St., Akron 18, Ohio.*

Phenolic molding compounds. Brochures CDC-324, 325, and 326 describe G-E 12902 (one-stage), 12906 (improved-impact), and 12920 and 12921 (general-purpose) phenolic molding compounds, respectively. 4 pages each. *Chemical Materials Dept., General Electric Co., One Plastics Ave., Pittsfield, Mass.*

Textile yarns. Catalog TYN-1 contains a yarn comparison table listing fibrous glass continuous-filament yarn data and equivalent yarn counts of cotton, worsted, and rayon. It also discusses the manufacture, nomenclature, physical properties, and applications of fibrous glass. 8 pages. *L.O.F. Glass Fibers Co., 1810 Madison Ave., Toledo 1, Ohio.*

Carbon black. "Readin'-'Ritin'-Ridin' with Carbon," a 31-min., 16-mm., color and sound film, describes modern production and industrial uses for carbon. Available for loan. *Columbian Carbon Co., 380 Madison Ave., New York 17, N.Y.*

Plastics

Production and sales figures in 1000 lb.* for June and July 1956

Materials	*Total p'd'n first 7 mos. of 1956‡*	*Total sales first 7 mos. of 1956‡*
Cellulose plastics:[a]		
Cellulose acetate and mixed ester		
Sheet, under 0.003 gage	11,105	11,456
Sheets, 0.003 gage and over	9,133	8,988
All other sheets, rods, tubes	4,490	4,334
Molding, extrusion materials	49,637	48,834
Nitrocellulose sheets, rods, tubes	3,430	3,066
Other cellulose plastics	3,201	2,928
Phenolic and other tar-acid resins:		
Molding materials[a]	133,922	117,426
Bonding and adhesive resins for:		
Laminating (except plywood)	36,931	25,133
Coated and bonded abrasives	9,267	9,716
Friction materials (brake linings, clutch facings, etc.)	10,075	8,779
Thermal insulation	33,115	32,710
Plywood	24,991	20,186
All other bonding uses	19,937	19,584
Protective-coating resins	17,281	15,733
Resins for all other uses	18,269	15,984
Urea and melamine resins:		
Textile-treating resins	26,246	23,841
Paper-treating resins	14,203	13,408
Bonding and adhesive resins for:		
Plywood	60,682	55,901
All other bonding and adhesive uses, including laminating	14,817	13,207
Protective-coating resins	20,939	15,150
Resins for all other uses, including molding	49,929	47,190
Styrene resins:		
Molding materials[a]	257,358	234,703
Protective-coating resins	55,923	54,126
Resins for all other uses	57,908	57,372
Vinyl resins, total[b]	429,183	400,172
Polyvinyl chloride and copolymer resins (50% or more polyvinyl chloride) for:		
Film (resin content)		42,995
Sheeting (resin content)		32,512
Molding and extrusion (resin content)		112,475
Textile and paper treating and coating (resin content)[c]		34,298
Flooring (resin content)		34,207
Protective coatings (resin content)		16,198
All other uses (resin content)		39,511
All other vinyl resins for:		
Adhesives (resin content)		21,641
All other uses (resin content)		66,335
Coumarone-indene and petroleum polymer resin:	141,951	138,842
Polyester resins:	41,859	37,390
Polyethylene resins:	305,551	284,181
Miscellaneous:		
Molding materials[a, d]	24,860	21,467
Protective-coating resins[e]	5,869	3,006
Resins for all other uses[f]	69,310	62,878

*Dry basis designated unless otherwise specified. †Revised. ‡Partially estimated. **Included with "All other bonding uses." [a]Includes fillers, plasticizers, and extenders. [b]Production statistics by uses are not representative, as end use may not be known at the time of manufacture. Therefore, only statistics on total production

Production

From statistics compiled by
the U. S. Tariff Commission

June†		July‡	
Production	*Sales*	*Production*	*Sales*
1,973	2,028	1,112	1,331
1,413	1,320	817	1,178
670	641	426	510
7,254‡	7,245‡	5,872	5,769
487	391	344	323
407	389	370	262
18,991	17,830	13,455	13,020
5,106‡	3,463‡	3,929	2,619
1,186	1,512	1,031	1,241
1,361‡	1,170‡	**	**
4,945‡	3,916‡	4,436	4,776
3,600‡	3,175‡	2,640	2,057
2,839‡	2,587‡	3,414	3,475
2,293‡	2,536‡	1,793	1,882
2,580‡	2,180‡	2,302	2,105
2,717‡	2,519‡	2,386	2,977
2,173‡	1,738‡	1,411	1,451
10,270‡	8,776‡	6,633	6,632
2,196‡	1,779‡	1,314	1,476
2,535‡	1,655‡	2,196	2,020
7,727	6,024	4,157	5,993
36,090	26,967	34,154	27,254
7,895‡	6,797‡	5,978	6,463
7,933	7,298	7,123	7,118
54,796‡	52,697‡	49,751	48,481
	5,345		4,722
	4,217		3,714
	14,926		15,203
	4,707		4,298
	5,316		4,231
	2,364		2,681
	5,228		2,321
	2,863		3,165
	7,731		8,146
19,465	19,031	19,241	19,066
6,212‡	5,617‡	5,641	5,464
45,634	44,137	45,998	38,826
3,512	2,796	2,841	2,586
981	453‡	844	439
9,659‡	8,676‡	8,899	7,973

are given. [c]Includes data for spreader and calendering-type resins. [d]Includes data for acrylic, nylon, and other molding materials. [e]Includes data for epichlorohydrin, acrylic, silicone, and other protective-coating resins. [f]Includes data for acrylic, rosin modifications, nylon, silicone, and other plastics and resins for miscellaneous uses.

Factory-sealed display package

For the first time in the history of the wrist watch industry, a factory-sealed transparent styrene package that protects the watch until it is in the consumer's hands is being made available by Gruen Watch Co.

The cylindrical package is made up of three molded styrene parts —the cylinder itself; a concave-shaped light-catching top which is cemented to the cylinder; and a base in which the cylinder rests. A series of lugs machined into the bottom of the cylinder are designed to slip into a matching set of holes cut into a molded-in ledge running around the inside of the base. Thus, when the cylinder is turned slightly, the lugs move under the ledge, locking the two pieces together.

A decorative strip of gold-metalized Mylar polyester film tape with a pressure-sensitive adhesive backing is then wrapped around the bottom of the cylinder, after which the package is "sealed" with a strip of adhesive-backed gold foil that is adhered at both the cylinder and the base.

The watch itself is mounted inside the cylinder on a stand that rests in a molded-in base slot.

Credits: Package produced by Braun-Crystal Mfg. Co., Middle Village, N. Y., using styrene supplied by Catalin Corp. of America

Styrene base and cylinder of package are "sealed" with gold-foil strip

Light pressure on diaphragm dispenses drops of uniform size from tip

Polyethylene medicine dropper

Completely assembled of molded polyethylene parts (five in all) a new medicine dropper offers accurate control of drop release and control (during manufacture) of the size of droplets.

The molded parts consist of a cap with molded-in threads, a band surrounding the cap, a metering diaphragm on top of the cap, a dispensing tube, and a tip. All the parts are press-fitted together; the diaphragm is snapped into a recess molded into the cap.

Control of drop release is accomplished by the metering diaphragm which, under gentle finger pressure, forms droplets of uniform size at the tip opening. The size of the droplets depends on the size of the tip opening, a dimension which is precisely determined in molding. Thus the dropper can be supplied with a tip opening which is best suited to the viscosity of the liquid.

The resistance of polyethylene to chemicals makes the dropper safe for dispensing drugs without danger of contamination; the fact that the material is virtually unbreakable also makes it an obvious choice for the application.

Credits: Medicine droppers are molded by Lumelite Corp., Pawling, N. Y., using polyethylene supplied by Bakelite Co.

Printed circuit parts kit

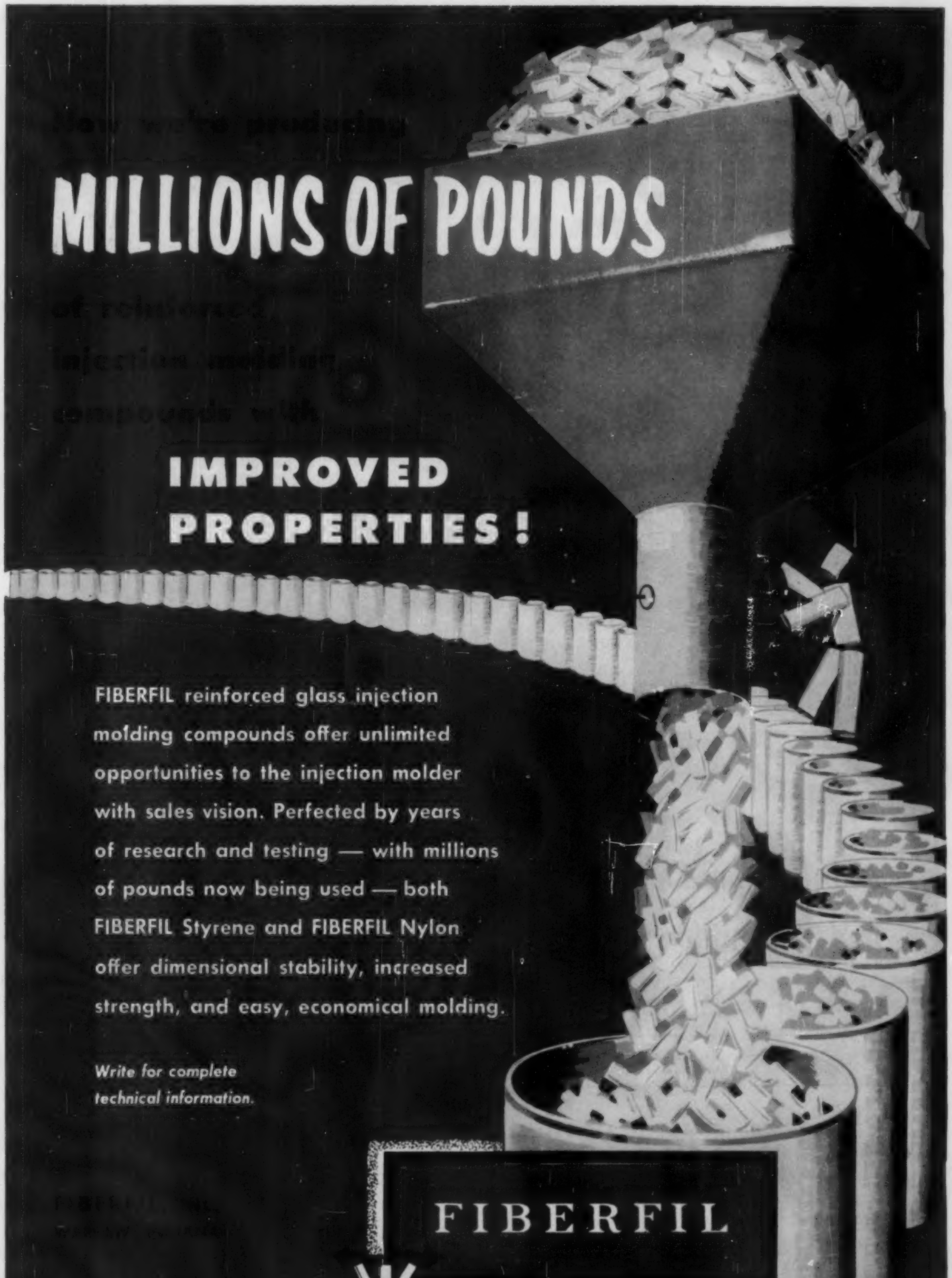
Plastics laminates are basic to most of the printed circuits which have caused such a revolution in miniaturization of electronic equipment and are still finding new applications almost daily. Such laminates, coated on one or both sides with copper foils or sheets, serve both as the physical support for the finished unit and as the electrical insulation.

Commercial methods of producing printed circuits vary greatly in detail and complexity, but even the simplest call for the use of tapes, paints, photo-sensitive coatings, negatives, etc.

Sensing a need for a method of producing engineering or prototype models of printed circuit parts with a minimum of trouble and expense, Photocircuits Corp., Glen Cove, N.Y., has developed a complete kit for such purposes. With the material in this kit a completely etched electrical circuit can be made ready for assembly in only 30 minutes. A newly developed drawing pen is used to draw the pattern, eliminating the need for more complicated accessories.

The kit consists of the pen, etchant-resist ink, etching powder, drawing guide, 10 sheets of paper-phenolic laminate with copper faces, and detailed instructions. The kit is supplied in a molded polyethylene container, made by Republic Molding Corp., Chicago, Ill., which also serves as the etching tray.

Paper-phenolic laminate is base of copper coated sheets supplied with kit for making printed circuits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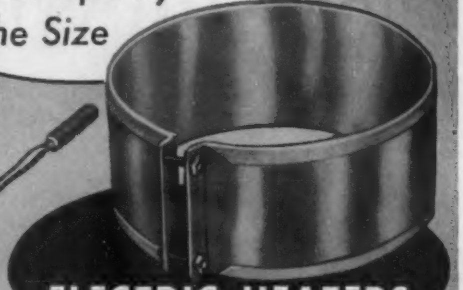
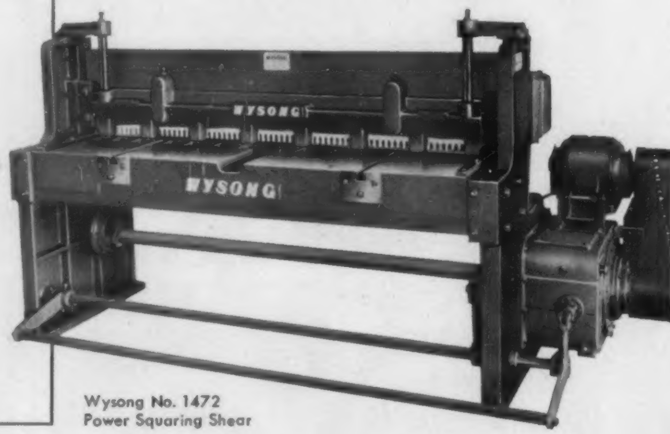
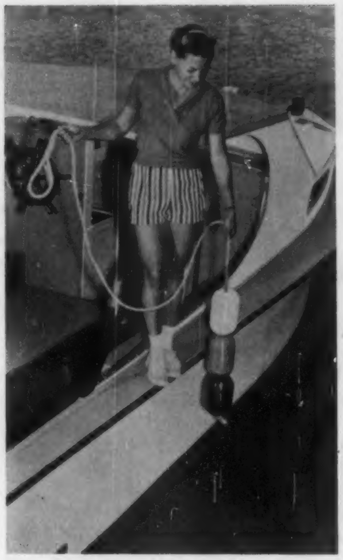




Wysong No. 1472
Power Squaring Shear



Vinyl plastisol floats strung on rope serve as non-marring boat bumper

Marine floats

Brightly colored floats that will not shatter, rot, mildew, or become waterlogged can double as boat fenders or marine line markers. Hollow and molded in one piece of vinyl plastisol, the new floats are long lasting, light in weight, and highly buoyant. While they are extremely tough, they can be punctured with a sharp point; however, if such damage should be done it can be easily repaired by sealing the hole with a hot knife or with a soldering iron.

Standard colors are red, white, and blue, with special colors available when required. Because the pigments are thoroughly mixed with the plastisol while it is still in paste form, the color is an integral part of the finished product and cannot chip or peel off.

The floats are made in a variety of sizes: 3, 4, and 5 in. in diameter and ranging in length from 1½ to 9 inches. They are strung on lines through center holes and can be used singly or in groups. The resilient, smooth-surfaced plastic will not mar boat finishes.

Credits: Floats are molded by Flexible Products Co., Marietta, Ga., using a plastisol based on Bakelite vinyl resins.

Designers meet

The 12th annual meeting of the American Society of Industrial Designers (ASID), held at Lake Placid Sept. 26-30, had as its theme "New Horizons in Industrial Design."

Although the official program did not deal with the subject of plastics in design, it was clear from conversations with individual ASID members that they are keenly aware of the design potentialities of plastics. Many of the products described and shown in slides demonstrated good use of the aesthetic and utilitarian virtues of plastic materials.

The relationship of designer to client was discussed at sessions and a comparison was made by both designers and their clients of the "expert-client" and "consultant-client" relationships. The importance of the designer's being able to fit himself in smoothly with his client's team effort was emphasized.

Five ASID members currently working in underdeveloped foreign countries, summarized their experiences in helping the local artisans.

Dr. D. Schneider, psychiatrist, in the most thought-provoking talk of the meeting, advised designers to study in detail and carefully the relationship to the product of all aspects of the human person.

In another excellent talk, Attorney Lee Epstein of New York discussed the ways in which a designer can protect his work against piracy. Design patents must be based on functional considerations, but design copyrights based on aesthetic considerations may be granted even though the object designed has some functional value. The courts will usually stop a "pirate" from producing a very close imitation of an industrial design even if no patent or copyright has been issued, on the ground that it constitutes an attempt to deceive the consumer. In general, the courts reflect the ethics of the profession, and Mr. Epstein suggested that it would be to the members' benefit if the ASID promoted the highest standards of ethics among its own members.

From jeeps to giants

(*From pp. 103-109*)

Corp., Bristol, Va. The largest of these parts made for the motor truck industry are door liners and corrugated wall liners (see Fig. 11, p. 107). Liners for the loading doors provide a saving of 75 lb. each over those of conventional construction, while the corrugated reinforced plastic wall liners still further reduce the dead weight and increase pay load capacity of the vehicle.

Reinforced plastic nose shields for truck trailer bodies, also produced by Universal, weigh 20 lb. less than their metal counterparts, as shown in Fig. 12, p. 107. Universal's vent doors for insulated and refrigerated trucks are molded in two parts, with the inner section in the form of a hollow pan. A block of rigid, expanded type plastic insulation is placed in the pan before the doors are assembled.

Another manufacturer of reinforced plastic cab frontpieces is Bassons Industries Corp., New York, N. Y. The Bassons units are produced for Trailmobile Corp., a Pullman subsidiary. Molds used for the reinforced plastic units are said to be less expensive than those used for their metal counterparts.

Structoglas polyester laminate panels produced by International Molded Plastics, Inc., Cleveland, Ohio, are being used as roof skylights in trucks and trailers produced by Premier Mfg. Co., Indianapolis, Ind. The shatterproof panels provide bright natural interior lighting within the trucks, speeding deliveries by eliminating errors in identifying packages (see Fig. 13, p. 107).

Translucence is also one of the features of vinyl-coated nylon covers for open-top truck bodies, now being used by many truckers in place of conventional tarpaulin covers. Made by Domestic Film Products Corp., Millersburg, Ohio, the covers incorporate a balanced coating of Geon vinyl resin on both sides of the nylon material, giving the cover exceptional abrasion resistance to external chafing from tree limbs, etc., as well as resistance to internal abrasion resulting from contact with the trailer itself. Penetration of light through the material permits daylight loading without artificial light; the tarps also resist the effects of grease, oil, and mildew. Covers are electronically preseamed to any required width, eliminating the necessity of sewing and waterproofing approximately 30,000 stitches (see Fig. 14, p. 107).

Perhaps the ultimate in light transmission characteristics for a truck body is found in a fleet of seven 35-ft. trailers produced for Celanese Corp. of America by Veenema-Wiegers, Inc., Paterson, N. J. Made of reinforced plastic panels produced by Alsynite Co. of America, the $\frac{3}{16}$-in. thick walls of the trailer are so translucent that large type on packing cases stowed against the inner sides of the van can be read through them, as can be seen in Fig. 15. Suitable for any dry cargo, the vans have a total loading space of approximately 2130 cu. ft. and

weigh 8900 lb., or about the equivalent of conventional trailers three to five ft. shorter.

Refrigerated truck trailers

It is in the refrigerated type of truck body that plastics offer some of the most important advantages. In such bodies, the excellent thermal insulating properties of plastics combine with their inherent color, immunity to rust and corrosion, light weight, and other characteristics to provide the manufacturer a finished truck body having many unique points of superiority. By using a double-wall body construction with plastic foam or another suitable type of insulation between the two plastic faces, heat losses may be reduced to a minimum. In some types of reinforced plastic truck bodies now being built, even the conventional metal supporting members in the body walls are eliminated, thereby removing one of the most serious sources of heat loss.

On a refrigerated truck the superior thermal insulating characteristics of a plastic body may often permit smaller and less expensive refrigerating units to be used; moreover, unlike wood or metal bodies, the plastic units are immune to rust, rot, corrosion, and absorption of moisture.

Permoglas, Inc., Santa Ana, Calif., has turned out a large number of reinforced plastic insulated retail milk delivery truck bodies. In addition to a weight saving of 600 lb. over their metal predecessors, these bodies are rust proof, sanitary, and easy to maintain. One operator reports that with the plastic bodies, temperatures are held to within 6 to 8 deg. of those registered at the time they leave the dairy.

The Herman Body Co., St. Louis, Mo., is now insulating the floors of all its refrigerated wholesale delivery and ice cream truck bodies with Styrofoam for maximum insulating efficiency, lightness, and strength (see Fig. 16, p. 103). The foamed material has proved ideal for this application because of its high resistance to water vapor transmission; moisture pick-up of Styrofoam is negligible even when the material is

(To page 224)

immersed in water for some time. This is particularly important in a truck floor, which is subjected to much more moisture than the side walls. Herman uses a 4-in. layer of the plastic material in bodies where a product temperature of 40° F. is to be maintained, and a 6-in. thickness for its Zeromatic ice cream truck bodies, which operate at below 0° F.

A new type of sandwich panel developed by Haskelite Mfg. Co., Grand Rapids, Mich., which combines structural strength with excellent thermal insulating properties appears to offer great promise in truck body construction. Fruehauf Trailer Co., Detroit, recently delivered its first de luxe model of a quantity of Volume Van Reefers, incorporating the exclusive Fruehauf-Hasko-Struct corrugated plastic insulated sandwich panels. These panels incorporate in one unit the best properties of plastics, aluminum, and plywood, providing low cost and efficient transportation of food products and other materials requiring temperature controlled shipping conditions. See Figs. 17 and 18, p. 108.

The new Fruehauf body, as compared with other refrigerated vans, shows a 5% increase in payload volume with a reduction in total weight. Due to its completely sealed reinforced plastic surfaces and the specially designed joints of the Styrofoam core construction, the unit will not absorb moisture, with resultant loss in insulating value and increase in dead weight. Under extreme operating conditions, large refrigerated vans not built out of plastics may pick up as much as 1000 lb. of dead weight in the form of moisture absorbed by the insulation.

Latest truck developments

Probably the most advanced work now being done with refrigerated truck bodies incorporating plastic materials is that of The Heil Co., Milwaukee, Wis., one of the nation's leading truck equipment manufacturers. Working with glass cloth and mat, polyester resins, and balsa wood as an insulating core material, Heil has developed several types of Frigid-Lite truck bodies that can be produced by a unique one-piece molding process. Details of the Heil-developed molding method are not yet available.

Among the truck bodies being produced by the company by means of this process are over-the-road trailer tanks in capacities from 4000 to 5300 gal. for long distance transportation of milk, liquid foods, and chemical products; truck mounted tanks in capacities of 1500 to 2000 gal. for the collection of bulk milk at farms and, most recently, a refrigerated wholesale meat delivery body produced for Plankington Packing Co., Milwaukee, a Swift subsidiary (see Fig. 19, p. 109). Heil states that these bodies are the largest one-piece sandwich type plastic structures now being produced anywhere and that its production method removes previous size limitations.

More than 100 of the Heil Frigid-Lite units are now in service throughout the country. One

of the largest milk haulers in the Midwest, Bill O'Donell of Elkhorn, Wis., reports that his 5300-gallon trailers carry up to 1000 lb. more payload than metal tanks of the same weight, resulting in a saving of $100 during a typical month's operation. Chilled fresh orange juice transported from Florida to Newark, N. J.—a 40-hour trip—shows a temperature rise of only 1 deg., as against a 5 to 6 deg. rise when transported in conventional metal tanks. In New York State, The Dairymen's League is now operating six of the large tank units of the type shown in Fig. 1, p. 103. Of these, the first has traveled approximately 200,000 miles in two years and has not required a cent of repair or maintenance cost during that period. The structural strength of these units was demonstrated when a truck left the road and turned over, then was righted and kept in service for several weeks before the necessary minor repairs could be made. No milk was lost and the rigidity of the tank was credited with saving the life of the driver involved in this mishap.

The Heil Co. sees no obstacle to the production of refrigerated trailers and even refrigerated railroad cars through use of the Frigid-Lite process. Its efficient combination of structural strength and insulating efficiency permits use of thinner walls, greater carrying capacity and smaller, less costly refrigeration units. Department of Commerce figures showing approximately 125,000 refrigerated straight trucks and 40,000 refrigerated trailers in operation at the end of 1955, indicate the huge potential market for plastics in this field. With the rapid expansion taking place in frozen food products—consumption practically tripled from 4.6 lb. per capita to 12.1 lb. from 1946 to 1953—truck body manufacturers are constantly on the lookout for more efficient materials.

Not only do the present engineering and material application trends in the truck and truck trailer field appear to be translatable from the standpoint of railroad transportation, but they are also important to the future of the building field.—END

Disposable specula

(*From p. 113*)

ones that have to be taken back to the office in order to be sterilized.

To keep the plastic cones within the desired price range (200 disposable specula sell for \$3.25), Plaxall has devised a semi-automatic production line for turning out the cones continuously at the rate of 100,000 a day. Forming and blanking are done in a single operation on special equipment developed by Plaxall. Using a combination of pressure and vacuum, the specula are formed 32 at a time on a roll of 10-gage vinyl sheet. Despite the small diameter (1 in.), the funnel-shaped pieces are successfully drawn down to a height of 1⅜ inches. An undercut shoulder which permits the speculum to be snapped securely onto the otoscope and a turned-in lip at the small open end which protects the permanent speculum from soiling, are formed into the piece (see cross-section diagram, p. 113). The tab which the doctor pulls to remove the used specula is blanked out in the flat at the same time as the specula is die cut out of the roll. The formed pieces are automatically piled up in groups of 40 and fed into transparent acetate tubes. Force-fit into the tube at the bottom of the pile is an end-piece of the same general shape as the specula. As each speculum is used, the pile is pushed up from the bottom by this end-piece so that the specula can be removed one-by-one. At the top of the tube is a cap with raised lettering. Both end-piece and cap are formed by Plaxall of high-impact polystyrene sheet material.

In addition to its obvious physical advantages, the formed vinyl speculum has aroused the interest of the medical field in the over-all concept of disposability. For this one application alone, Plaxall is looking forward to a potential market running into 200 million units a year.

Credits: Vinyl sheet supplied by Bakelite Co.; high-impact styrene sheet supplied by The Gilman Bros. Co., Gilman, Conn., and Joseph Davis Plastics Co., Arlington, N. J.; acetate sheet by Celanese Corp. of America.

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VALVES FOR AIR CYLINDERS. Catalog describes series of solinoid and master air valves in ¼, ⅜, ½ inch sizes for controlling the operation of air cylinders to 150 p.s.i. Hanna Engineering Works. (K-612)

PLASTICS MATERIALS AND RESINS CATALOG. 14-page brochure summarizes data for company's urea, melamine, methylstyrene molding compounds; polyester, laminating resins; resin adhesives. Includes properties charts. American Cyanamid Company. (K-613)

STOCK PLASTIC KNOBS AND HANDLES. Illustrated catalog describes line of control knobs and handles, stock molded from thermosetting phenolic or urea materials. Blueprints give dimensions for a variety of sizes and shapes. Rogan Brothers. (K-614)

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LAMINATED RODS AND TUBES. 12-page catalog describes laminated thermoset rods and tubes suitable for electrical, chemical, mechanical applications. Includes detailed charts on tolerances, tubing and rod standards, government specifications, and shapes, sizes, colors available. Synthane Corporation. (K-620)

PLASTICS EXTRUDING EQUIPMENT. 6-page folder describes line of thermoplastic extruders with sizes of from 1 to 12 inches for extrusion. Accessory equipment also available. National Rubber Machinery Co. (K-621)

AUTOMATIC INJECTION MOLDING MACHINE. 6-page folder describes line of fully automatic hydraulic injection molding machines with 1½, 3, 8, 12 ounce capacities. Includes specifications. Meiki Co. Ltd. (K-622)

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PLASTICS ROD AND TUBE CATALOG. 22-page catalog describes the characteristics, sizes, and tolerances of polyethylene, vinyl, styrene, methacrylate, Teflon, acrylic rods and tubing. Friedrich & Demmock, Inc. (K-623)

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PLASTICS PARTS FOR PRECISION APPLICATIONS. Folder describes company's precision components for use in the electronic and instrument industries. Production methods include machining and fabricating, molding and engraving of laminated phenolics, Kel-F, Nylon, methacrylate, polyethylene and rigid vinyl. Star Manufacturing Company. (K-625)

MOLDED PLASTICS CHART. 8-page booklet describes company's molding operations, and includes two-page comparison chart listing the molding properties of a wide range of the chief thermosetting and thermoplastic molding materials. Also describes plastics insulating material. General Electric. (K-626)

CIRCULAR SAW CATALOG. Folder describes tungsten carbide tipped circular saws for cutting plastic materials, available with standard or fine toothed edges. W. F. Meyers Company, Inc. (K-627)

LAMINATE FOR ELECTRICAL USE. Folder describes phenolic resin-bonded paper laminate for electrical applications. Available in standard sheet rolls or in sections and strips. Includes data on properties and test values. Troisdorf Plastics. (K-628)

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LAMINATED PIPE. Folder describes corrosion-resistant, chemically inert laminated "Teflon" pipe. Blueprints provide specifications, installation data. Includes description of flexible hose and tubing. Resistoflex Corp. (K-631)

FUNDAMENTALS OF DRY COLORING. Folder describes the procedure, materials, and equipment required to apply coloring agents to uncolored thermoplastic particles which are to be molded or extruded. Includes discussion of company's dispersants and colorants. Plastics Color Company. (K-632)

POLYESTER REFERENCE MANUAL. 52-page reference manual gives chemical data on unsaturated polyesters, illustrates applications, gives formulations for preparation of polyesters and polyester varnishes, and lists some available literature on the subject of polyesters. Allied Chemical and Dye Corp. (K-633)

HIGH SPEED HOMOGENIZER-MIXER. 8-page booklet describes line of mixers, capable of from 3500 to 7000 r.p.m., depending upon model. Suitable for the blending and homogenizing of plastics and other materials. Illustrations show rotar-stator mechanism, diagrams indicate specifications. Gifford-Wood Company. (K-634)

HANDLING WEB-FED PAPER AND FILM. 12-page booklet describes photoelectric edge position control equipment suitable for use in web printing or wrapping operations. Includes models for medium, heavy, extra heavy duty. Askania Regulator Company. (K-635)

AUTOMATIC SPRAY PAINTING MACHINES. Illustrated sheet describes, gives specifications for spray painting machine, designed for single color decorating of small and medium size parts. The machine is completely enclosed, requires no spray booth. Conforming Matrix Corporation. (K-636)

VACUUM FORMING. 12-page bulletin describes the vacuum forming technique, indicates scope of applications and describes instruction and operational features of a line of vacuum forming equipment. Specifications included. Vacuum Forming Corporation. (K-637)

ELECTRIC HEAT IN PLASTICS PROCESSING. 34-page booklet describes many cases where company's strip, ring, tubular and cartridge heaters were used successfully by plastics processors for preheating, drying, curing, fusing and other purposes. Edwin L. Wiegand Company. (K-638)

AUTOMATIC HYDRAULIC PRESSES. Detailed specifications sheet describes three molding presses for thermosetting materials. Information given includes platen area, stroke, closure speed, etc. Baker Brothers, Inc. (K-639)

WEIGH FEEDER FOR INJECTION MOLDING MACHINES. Folder describes automatic net weighing machine, designed to weigh-feed a pre-determined amount of plastic molding material to injection molding machines. Specifications and dimensions are included. The Exact Weight Scale Co. (K-640)

RADIANT HEATING ELEMENTS. Illustrated bulletin describes construction, special features and uses for a line of infra-red radiant rod oven sections for drying, preheating and curing operations. Specifications included. The Fostoria Pressed Steel Corporation. (K-641)

VARIABLE SPEED ELECTRIC DRIVE. 12-page illustrated brochure shows many actual installations using company's "VS-Jr." drive motor, available from ¼ to 3 h.p.; drive uses no mechanical connecting devices and features smooth starting and stopping; stepless adjustable speeds; "plug-in" operation. Reliance Electric & Engineering Company. (K-642)

INFRARED OVENS. Illustrated 20-page brochure describes extensive line of radiant-heat ovens designed for baking, drying, and preheating. Discusses operating principles and maintenance. Fostoria Pressed Steel Corp. (K-643)

STABILIZERS. Bulletin contains suggested vinyl stabilizer combinations for plastics coating, molding, forming, and dip coating applications. The Harshaw Chemical Co. (K-644)

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As a primary plasticizer extender, the advantages of Conoco H-300 merit the consideration of all quality-minded and cost-conscious formulators using polyvinyl chloride resins. Some of these are:

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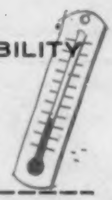
Tests prove that films containing Conoco H-300 show light resistance equal to, or better than, those with no extenders—a unique contribution in the field of secondary plasticizers.



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Mixtures containing Conoco H-300 have appreciably lower initial and aged viscosities.

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Can save the processor as much as 2 cents per pound on the finished product. Conoco H-300 can be used to the extent of 25% of the total plasticizer required.

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Petrochemical know-how from the ground up!

CONTINENTAL OIL COMPANY

Sweden

(*From pp. 120-123*)

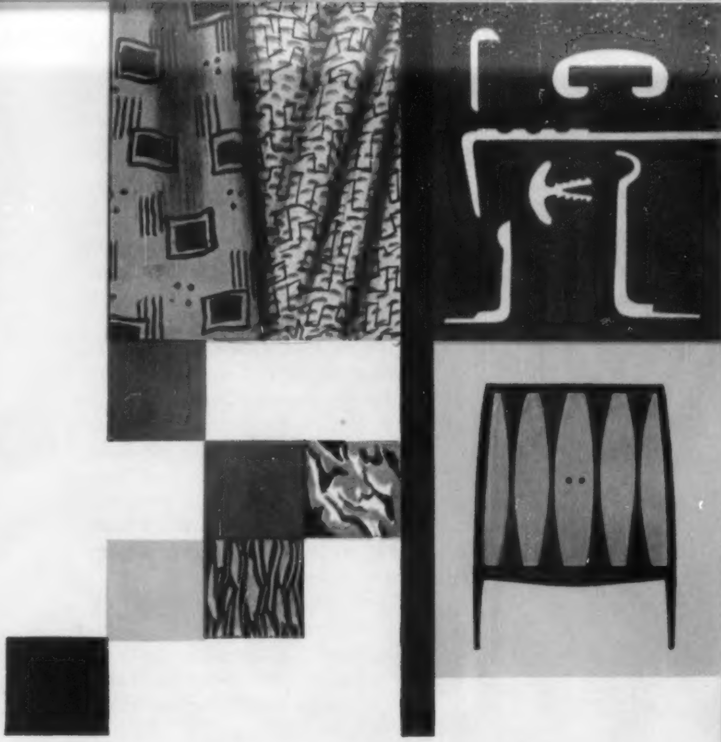
that the laminator and the resin supplier generally have been the same company. Other semi-finished or finished products are, however, usually manufactured by companies other than material makers.

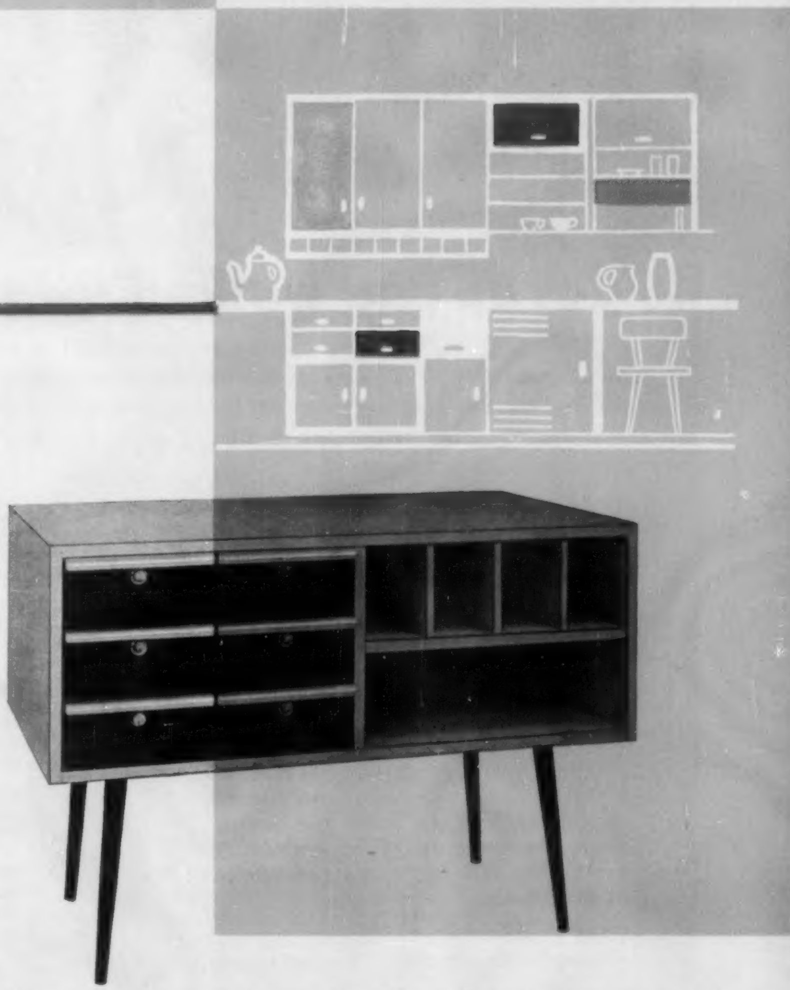
The vinyl processing industry is very well developed and has a good reputation, at home and abroad, for high quality products. Eight companies are manufacturing calendered film and sheeting, ten companies are equipped for coating fabrics and paper with PVC, four companies are manufacturing PVC flooring materials, at least a dozen companies are processing plastisols and organosols by dip coating, about 25 companies including the cable industry are extruding PVC and other thermoplastics, and one company is extruding rigid PVC. On the fabricating side, at least ten companies are equipped for hot gas welding and fabricating of rigid PVC. Most of these firms have specialized in the manufacture of corrosion-resistant equipment for use by the chemical industry.

Of the companies equipped for extruding, at least four or five are in rather large-volume commercial production of polyethylene tubes and four companies are each employing several extruders for extrusion blowing of polyethylene film.

There is one manufacturer of viscose film, AB Celloplast, Norrköping, which is partly owned by British Cellophane Ltd., England, and La Cellophane, France, and with which the company has a technical working agreement. This company also manufactures cellulose acetate and polyethylene film. Two specialized products are viscose sponge materials and a thermal insulating material made of corrugated cellulose acetate film, known as Isoflex. The export of viscose film is rather important and in 1955 was 1000 tons. Import was about 600 tons, and it was primarily second-grade material.

One company, AB Tidan, Mariestad, manufactures vulcanized fiber; the volume of this





production is enough to cover the Swedish requirements and also allows for export.

Two companies are manufacturing phonograph record compounds based on PVC. They are AB Klosters Fabriker, Jönköping, and N Lundbergs Fabriks AB, Boras.

Three companies are manufacturing corrugated sheets of fibrous glass reinforced plastics. They are AB Bofors Nobelkrut, AB Gustavsbergs Fabriker, and AB Volamin, Gothenburg. The last mentioned company also manufactures a type of decorative laminate on paper base with a polyester as binder.

Two companies, Svensk Celluloidindustri AB, Gislaved, and Nordiska Gummifabriks AB Overman, Sundbyberg, are manufacturing polyurethane foams and are both licensees of Farbenfabriken Bayer A. G. in Germany. Other companies are manufacturing blocks, sheets, and moldings of foamed styrene.

Fabricating, vacuum forming

The number of fabricators of acrylic plastics and other rigid thermoplastics in sheet form, as well as of laminates, is comparatively small, but there is an increasing interest in vacuum forming. The total number of companies in this field is believed to be about 30 or 40 of which at least a dozen are equipped with vacuum forming machines. Materials for this branch of the industry have to be imported. One company in the extrusion field is expected to come into production with extruded styrene alloy sheets during the present year.

The nitrocellulose fabricating industry is rather small, only about half a dozen firms, and as there is no production of celluloid, the materials have to be imported. The import in 1955 was about 125 tons.

High frequency welding and heat sealing

The number of firms equipped for high frequency welding of PVC film and sheeting is steadily increasing and there is also a number of companies equipped for heat sealing of polyethylene film, mainly for packaging pur-

poses, besides the two big companies in the packaging field, Esselte Förpackning AB, Norrköping, and AB Äkerlund & Rausing, Lund. A daughter company of AB Äkerlund & Rausing, AB Tetra Pak, has developed a special tetrahedron-shaped package for milk and cream, which is made on special equipment from paper coated on the inside with polyethylene. This application is expected to be one of the biggest single outlets in Sweden for polyethylene in the future and is now being introduced and exported.

Compression and injection molding

The number of compression molders can be estimated at about 150 firms, ranging from very small firms with one or two presses to some large companies having several hundred presses.

The number of injection molders is believed to be in the order of 200 to 225, and the total number of injection molding machines in all capacities may well be 500. Total press capacity is estimated to be about 100,000 tons and the total shot capacity of the available injection molding machines is estimated to be in the order of 12,000 to 15,000 grams. The number of injection molding machines in the last few years has increased by 7 to 8% yearly, mainly in the category of machines with a capacity ranging from 3 oz. to 8 ounces. However, some companies also have large machines and there are today not less than four 48 to 60 oz. machines, two of which are of American and two of Italian make.

Reinforced plastics

The interest within and without the plastics industry in reinforced plastics has been and still is big, but only about a dozen companies have entered commercial production. There is one company manufacturing various types of small boats. One of the Swedish car manufacturers is equipping a sports model intended for export with a body at least partly made of reinforced plastics. Another company is manufacturing tanks for transporting gasoline, oils, and other fluid products. Still other companies are engaged in the

manufacture of radomes and parts for aircraft and other types of military equipment. Among other civilian products being manufactured are crash helmets, fishing rods, various types of boxes, and cases.

The total export of semi-finished and finished reinforced plastics products is growing. Thus, the increase for these two groups of products, 1955 over 1954, volumewise was 54.3%, and 44.3% valuewise.

Machinery and equipment

While much machinery and equipment has to be imported, a few companies have standard lines of compression presses, injection molding machines, rolls, and high frequency equipment.

AB Alpha, Sundbyberg, is manufacturing some types of highly automated hydraulic presses, ranging from 100 to 200 tons in capacity; this company has also developed a special line of phonograph record presses suitable for shellac compounds as well as the modern PVC compounds. It also manufactures testing apparatus for plastics.

Bröderna Äkesson, Mekanisk Verkstad, Hälsingborg, has specialized in some of the smaller sizes of injection molding machines. This company, as well as Industri AB Plastics, Skara, and AB S. Fägersten & Co., Gothenburg, also manufactures various types of smaller compression molding presses. Fjellmans Mekaniska Verkstad, Mariestad, well known to the wood processing industry, is manufacturing some special types of low pressure presses suitable for the reinforced plastics industry and also presses that are being used for thermoforming of rigid sheet materials. Some companies, such as Mohögs Mekaniska Verkstad, Skönsmon, and AB Abjörn Andersson, Svedala, manufacture rolls and like equipment for the plastics and rubber industries.

Three companies, Flodins Industri AB, Lysekil, Svenska AB Philips, Stockholm, and AB Zander & Ingeström, Stockholm, are producing high frequency preheaters as well as welding equipment for plastics.

Many of the bigger companies

equipped for compression and in-

equipped for compression and injection molding as well as vacuum forming usually manufacture the main part of their molds themselves, but several firms all over the country have specialized in the manufacture of molds for the plastics industry.

Swedish Plastics Federation

Per capita consumption of plastics in Sweden rose from 4.6 kg. in 1953 to at least 5.25 kg. in 1956. Much of this progress has been due to the activities of Svenska Plastföreningen (SPF, The Swedish Plastics Federation), which was established in 1946 under the name Svenska Konsthartsföreningen and has today about 270 members.

Members of the Federation are not only the manufacturers of finished and semi-finished products, raw materials, chemicals, and machinery and equipment for the plastics industry, but also Swedish agents for some of the major foreign raw materials and machinery manufacturers. The Federation offers an active information service to the membership and arranges two yearly meetings one of which, the Fall Meeting, is mainly technical. Last year's meeting, "Plastteknik" 1955, was attended by about 650 persons, 200 from abroad. A total of about 50 technical papers were read at the meeting, some in English, others in German and in Swedish.

This year the Federation is celebrating its 10th Anniversary by arranging the Second Swedish Plastics Exhibition at Ostermans Marmorhallar in Stockholm from October 27 to November 4. The Fall Meeting "Plastteknik" 1956, will take place during the Exhibition period from October 29 to 31. The main purpose of this Exhibition, which has been entitled "Vi ser pa plast" (We Look at Plastics) is to inform the consuming public and industrial end users about plastics and plastics applications. In total, about 70 firms are exhibiting.

Labelling program

The Federation is preparing an informative and color identifying labelling program, which is being

(*To page 242*)

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introduced at the Exhibition. Swedish as well as foreign firms are participating in the Exhibition and they are all backing up this labelling program by marking all exhibited products with the corresponding labels. Standard labels for all the main commercial types of materials are being designed. Each type of material is identified by a special color or color combination, and the standard text on each label contains the technical name of the material in question and also some pertinent data concerning its properties, good as well as bad. When necessary, some hints concerning the right handling of the product are given. Space is available on the labels for a registered trade name. The Federation hopes that this identifying and labelling program will find wide acceptance not only in the industry, but in the distribution set-up, so that in the near future the manufacturers will be encouraged to use an informative label to sell their products.

Standardization in Sweden

Work on standardization in the plastics field was started during the last war, at which time it was sponsored by the forerunner to the Federation, Svenska Konsthartsindustriens Ravaru- & Importförening, an organization which was formed in order to assist the authorities on problems concerning the import and distribution of the plastics materials which were required to cover the most essential needs of industry during the war. Standardization is now being carried out by a special organization, Plaststandardiseringen, the Plastics Department of Sveriges Standardiseringskommission (Swedish Standards Association). The Federation is in several ways supporting this work.

Up to now the standardization work has resulted in the publication of about two dozen standards, covering testing methods as well as material specifications. Plaststandardiseringen is also actively participating in the Standards Committee on Plastics within the International Standards Organization, ISO/TC 61 Plastics.—END

Better conveyor belt

(*From pp. 124-125*)

cessor can have the belt installed quickly and economically, either by itself or over a core material.

Candy industry

Where candy or ice cream have to be conveyed through cooling tunnels, the polyester film belting has proved especially applicable. In handling chocolate covered candy and ice cream, in particular, the smooth surface of the belt is ideal for imparting a glossy appearance to the bottom of the chocolate coating that is similar to that on the top and sides of the product. For those manufacturers working with chocolate covered creams, the smooth surface also prevents the formation of small holes in the bottom of the coating which result in leakage of the cream.

Goldenberg Candy Co., Philadelphia, Pa., is one manufacturer that has been using polyester film as enrober tunnel belting since October 1955. Since that time, the 128-ft. belts have been subjected to continuous temperatures of 40° F. without losing their high gloss surface (as other belts have done after a few months service). Reportedly, the service life of the polyester belts has thus far proved out to be at least 1½ times greater than belting previously used. In addition, since the film dissipates heat more rapidly than fabric belts, faster cooling is possible.

Another use for the laminate material is in the form of flat plaques or trays on which the candy is carried from the enrober to a multi-tiered cooler. Here the plaques with the candy on them are attached to a vertical-traveling chain conveyor that conveys them upwards. Stephen F. Whitman and Son, Philadelphia, who have been using this type of plaque since October 1955, report that the plaques have provided consistently high gloss bottoms on the chocolate candies. In addition, the resistance of the polyester to cocoa butter has greatly increased the life of the plaques.

The plaques are cut to size from rolls of the laminate material. A strip of double-coated polyester film pressure-sensitive tape is

ANNOUNCING--
1957 KOPPERS
DESIGN COMPETITION
FOR PLASTIC HOUSEWARES

WHAT...

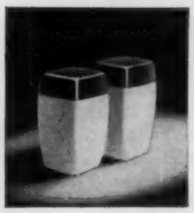
Koppers Annual Design Competition will be conducted again in 1957 to award recognition to the best designed polystyrene and polyethylene housewares in the country.

HOW...

If you haven't already received a copy of the official entry blank or would like additional copies, write the Competition Administration Committee, 1313 Koppers Building, Pittsburgh 19, Pennsylvania, or contact any Koppers Plastics representative.

WHY...

This annual competition lends tangible backing to the concepts outlined in the "Statement of Principles by the Plastics Industry." By lending full advertising and promotional support to housewares of superior design and imagination, public acceptance of plastic housewares will be steadily increased.

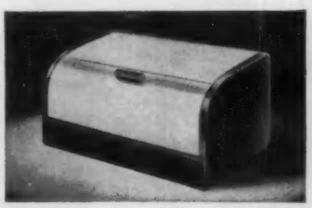


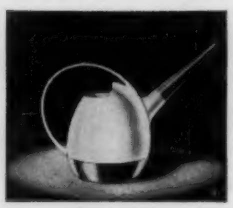
WHEN...

All entries *must* be submitted not later than February 15, 1957. Molders entering the 1957 Design Competition will be featured in a special two-page advertisement in *Housewares Review*. Judging will take place February 27, 28 and March 1 followed by an award banquet April 2—both in Pittsburgh.

WHO...

Any molder, extruder, fabricator or proprietary manufacturer, regardless of whose materials are used, may enter houseware items made of regular, modified or expanded polystyrene, as well as regular or modified polyethylene. Entries will be judged in four separate classes. There will be a Best-Of-Competition award, four First prizes, four Honorable Mention awards and four Most Original winners (at judges' option).





JUDGES...

Judging of entries will be done by an impartial panel of authorities in the fields of design, engineering and homemaking. They are **Jesse H. Day**, Ph. D., Editor, *SPE Journal*, Member, Society of Plastics Engineers; **Jay Doblin**, Director, Institute of Design, Illinois Institute of Technology, President of the American Society of Industrial Designers; and **Mabel A. Rollins**, Ph. D., Head, Department of Economics of the Household and Household Management, Cornell University.

1957 KOPPERS Design Competition FOR EXCELLENCE OF CREATIVE DESIGN IN PLASTIC HOUSEWARES

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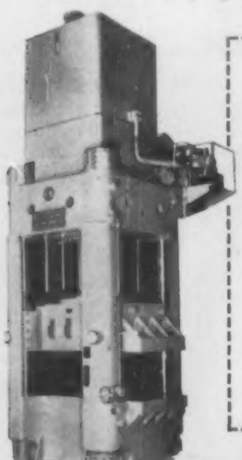

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used to create a loop at the back of the plaque. The metal rod that attaches the plaque to the chain conveyor passes through this loop.

Other industries

The baking industry similarly has high hopes for the polyester belting as a means of cutting down on production costs. One belt in use today carries doughnuts, still hot from the frying vat, to a bin where powdered sugar is applied. Belting formerly used in this operation deteriorated rapidly from constant contact with cooking oils. A large super-market chain has also installed polyester film belting for its iced baked goods.

The resistance of the film to attack by meat acids, alkalies, and other chemicals is important to other food processors. A sauerkraut manufacturer, for example, who had previously been unable to find a material to withstand his highly acid product, was able to install a conveyor system for the first time by using polyester film. Meat packers also report that initial tests show that this belting may offer longer life in their industry because of its resistance to animal fats and greases.

In the citrus fruit industry, where belts must be both strong and immune to attack by citric acid, the new belting also has considerable potential. And a frozen food manufacturer believes the belting will make possible a continuous production line involving freezing of food products at temperatures of —40° F.

In addition to food processors, other industries that should find use for the belting include pharmaceutical houses, tobacco operations, rubber products manufacturers, and chemical plants where belting is required with strength and good release properties. Gates Engineering Co., Wilmington, Del., for example, is using the belting to process sticky calendered rubber stock. The new belting eliminated the need for a release liner formerly required for the fabric belt.

Credits: "Permagloss" conveyor belts distributed by Mohawk Supply Co., Philadelphia, Pa. Mylar polyester film supplied by E. I. du Pont de Nemours & Co.

Luggage goes places

(From pp. 126-129)

tion. In the very near future, ladies' matching units will be made available. It is interesting to note in this connection that the luggage has been engineered so that, although there will be only four basic cases in the line, the different size shells for these cases can be combined in varying combinations to make additional models. The tops from two ladies' weekenders, for example, can be joined together without modification to make a man's flight case. (See sketch, p. 128.)

The anticipated retail price for the 21 in. case will be somewhere around $30; the two-suiter around $45. While this is in a popular-price category, the advantages which the new luggage offers are such as heretofore have been available only in much higher-priced luggage. Added to this, of course, is the fact that the new luggage is considerably lighter in weight than the higher-priced models.

The Regal-Aire line is available in tan, grey, black, two-tone grey, or two-tone chestnut red—all in colonial grain finish. Linings are currently available in either beige or grey.

Portfolios and brief cases

Another significant application of styrene copolymer sheet, this time in the area of portfolio and brief cases, attache cases, flight kits, and salesmen's catalogue cases, is in a new line being offered by Boyle Leather Goods Co., Inc., New York, N. Y. All of the models in the Boyle Impactolite line are made up of two identical pressure formed Royalite shells joined together with a zipper-type center. As with the Regal line, to cut down tooling costs, the Impactolite line has been engineered so that a full line of cases (in both 16 and 18 in. lengths with widths varying from 4½ to 8 in.) can be turned out using a single size shell. All that is necessary is to vary the width of the zipper web which joins the shells together.

Interiors of the cases are lined with a fine suedine in various pocket arrangements. Large bottom studs keep the case off the ground and heavy-duty symmetrical zippers equipped with double pulls are used for closing the cases.

Covering for shells

The physical advantages of styrene copolymer sheet have been adapted by U. S. Trunk Co., Fall River, Mass., in the form of 0.025 in. covering permanently molded over a resin-cellulose fiber contour shell. Because of the monolithic construction thus achieved, there are no joints or seams in the luggage to break open or split apart. In addition, the luggage is very light in weight and is much more durable than comparable pieces made of conventional materials. The formability of Royalite also makes it possible to use it as a one-piece covering. Plastic sheeting previously used for such a purpose, it is claimed, could not be drawn over sharp contours and for that reason had to be covered with decorative stripping in those areas.

Laboratory tests conducted by U. S. Trunk have shown the plastic luggage to possess more tensile strength, more shock resistance, and better abrasion resistance than conventional types.

U. S. Trunk's Royalite line, which will be known as Socialite, has a retail price range from $19.95 to $42.95 and includes five pieces for men (from a 21 in. overnight case to a 27 in. pullman) and seven pieces for women (from a 16 in. round hat box to a 27 in. pullman). Colors available in the Socialite line include golden tan, platinum grey, and sapphire blue.—END

Grained styrene copolymer sheet covering, 0.025 in. thick, is permanently molded over resin-fiber contour shell. (Photos, U. S. Trunk)

Interior of shell is lined with patterned crepe to complement design of plastics exterior of case

New markets

(From pp. 131-135)

trade in producing both nylon tubing and more particularly nylon pipe. Thin-wall nylon tubing of both types is now undergoing extensive tests in automobiles for central lubricating systems to carry oils and greases. This flexible tubing may be rolled into coils and handled easily during application. With a touch of the finger, key points in the family car may be lubricated with oil or grease carried by a nylon tube.

A more startling development has been the use of nylon-6 in the production of 5½-in.-diameter nylon pipe for oil field exploration work in England. One processor (Danielson Mfg. Co.) is now producing nylon pipe and offering it commercially for the first time in this country; and studies are now underway in the use of nylon pipe in breweries, milk plants, and the food processing industry. One advantage of nylon is that it does not impart an undesirable taste to liquids intended for human consumption. Industrial applications for nylon pipe capitalizing on its abilities to handle alcohols, aliphatic hydrocarbons, aromatic hydrocarbons, fats, greases, weak and strong alkalies, and solvents such as turpentine and kerosene should be a permanent basis for its growth. Here, too, high temperature stability and its low heat conduction should be of value in transporting hot fluids. Nylon pipes may be cleaned by steam sterilization and boiling water. Since these materials are new on the market, there are obviously a number of question marks regarding their stability in long-term contact with hot water and similar questions which must be answered before their widespread acceptance. If cost of resin is used as the chief criterion, it can be shown that nylon will compete pricewise with other plastics pipe since less material is needed per foot of pipe. Where extreme strength is not critical nylon will generally have a place wherever stainless steel pipe is used today. This could present a sizable market potential.

Nylon film

Nylon-6 film and laminates of nylon film with other films, e.g., polyethylene, appear to offer extremely interesting possibilities. The high clarity nylon film has both good tensile and high impact strength. Tests of nylon film for packaging oils, fats, greases, and butter are showing promising results in Europe. Blown nylon film is presently being used to package solvent and solvent-containing materials such as caulking and putty. Medical instruments and other items requiring exposure to autoclave temperature for sterilization should find nylon film useful. This material may also be used in contact with boiling water, for packaging foods, and other items requiring exposure to boiling water temperatures. Deep-drawn film is being tested for packaging sardines, oils, fats, and butter. Of greater interest to processors is the fact that nylon-

6-type film may be produced on conventional polyethylene equipment or conventional equipment only slightly altered.

In the final analysis, film is purchased on the basis of cost per square foot. At comparable strengths, it is interesting to note that nylon film closely approximates the cost of polyethylene film. In other words, if the cost of polyethylene film is 60¢ a sq. ft. and the cost of nylon film is $2.20 a sq. ft., when the comparative strengths of the two films are taken into account (polyethylene film with a tensile strength of approximately 2000 p.s.i. and nylon film with a strength of about 9200 p.s.i.), the cost at comparable strengths averages out to about 58¢ per sq. ft. for polyethylene and 56¢ per sq. ft. for nylon film. This means that nylon may be produced in thinner gages and still be competitive with polyethylene on a performance basis. In the figures quoted above, a higher processing cost for nylon was used since the techniques of extruding nylon film is not practical to the same extent as those for polyethylene. As nylon processing techniques become more widely practical, the cost of nylon film should be reduced below that used in this presentation, placing it in a better price picture. Running of nylon-6 film on conventional polyethylene equipment has produced film of good quality at 0.2 mil thickness.

Bottles and profiles

Nylon-6 bottles show promise because of high clarity, strength, and ability to contain items which normally attack polyethylene, such as the aliphatic and aromatic hydrocarbons which are not compatible with polyethylene. Development of special coatings and linings for polyethylene to protect these materials from oils, fats, and greases makes the cost picture attractive for nylon bottles, particularly when the greater strength is utilized in bottle design. It has been clearly shown that nylon-6 bottles may be produced on standard bottle making equipment. Several bottle makers have indicated that it is now possible to make nylon containers holding several gallons.

Window channels, weather stripping, track and slides, rollers, hardware, and various fixtures offer one of the largest possible areas for nylon growth. In this application, the high-melt-viscosity nylon-6 resins provide the processor with tools to make a number of complicated shapes. One area of use, for example, is in the automotive field where nylon shapes for weather stripping could require appreciable poundage. Several reliable sources have estimated that extrusion in this area of use alone could represent some 45 to 60 million lb. of resin by 1960.

General applications

Mechanical components for conveying equipment are using an increasing number of parts made from resilient nylon as a replacement for stainless steel at a reported 20 to 40% saving in costs. Too, the low coefficient of friction and the light weight of nylon

permits the part to be made at about ¼ the weight of the metal component without the lubrication requirements.

Advance design and automotive research personnel predict that upwards of 3 lb. of nylon could be used for each car in the future. Several automotive suppliers are increasing capacity to meet an automotive industry estimate of 10 million cars annually at the end of this decade. This could then pose a market of some 30 million lb. per year of nylon resins.

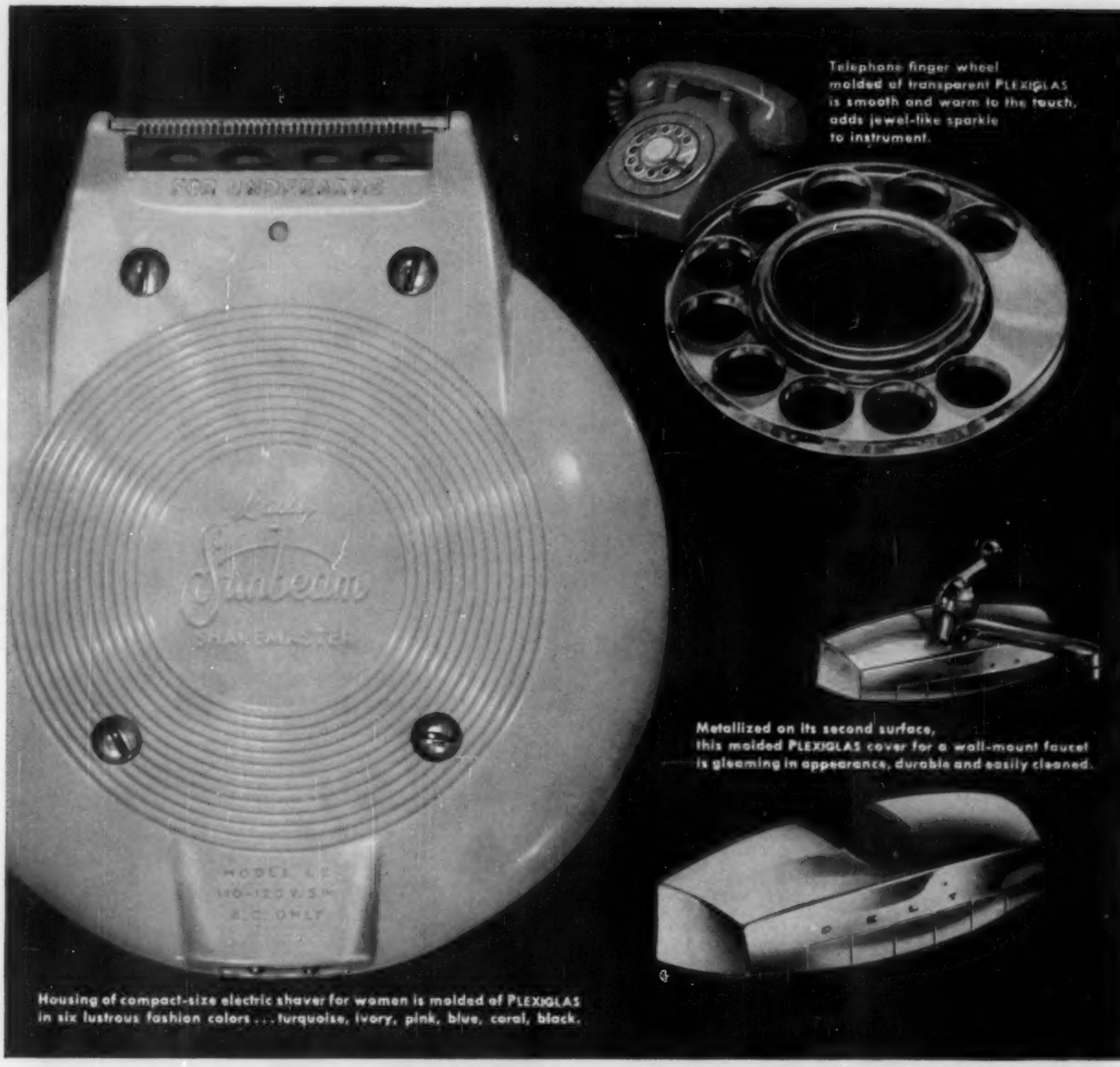
Where is nylon going?

Price has been one of the greatest deterrents to the growth of nylon. It should be noted, however, that nylon prices have decreased some $.27 per lb. over the past year and 50% in the more commonly used injection molding grades.

If this trend should continue, nylon on a price basis, would then become competitive with such metals as die cast zinc—thereby opening that substantial market.

Practical importance must be attached to the high melt viscosity resins, such as nylon-6, which in Europe at least have been proven particularly useful for extrusion and large moldings. The availability of this type nylon in the U. S. should give access to big new markets such as pipe and film which have heretofore been nonexistent.

Recent publications have estimated that the market for nylon resins in non-textile applications will be 50 million lb. in 1960. Extreme enthusiasm concerning the growth of nylon in injection molding, extrusion, and special applications such as rod making and powder coating is prevalent among those people most qualified to speak. It seems realistic to believe that with the introduction of one or two large poundage applications, the nylon market could change rapidly in both character and nature. Reason exists to believe that the consumption of nylon during 1960 could vary between 40 to 75 million lb. depending on how rapidly some of the applications discussed are accepted and what happens to the price.—End



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Accelerating effect

(*From pp. 153-168*)

comparing readings on both meters and was found to be well within the instrument's rated accuracy of ±2 percent.

It is obvious that still lower or higher ranges could be added, using the same procedure and formula.

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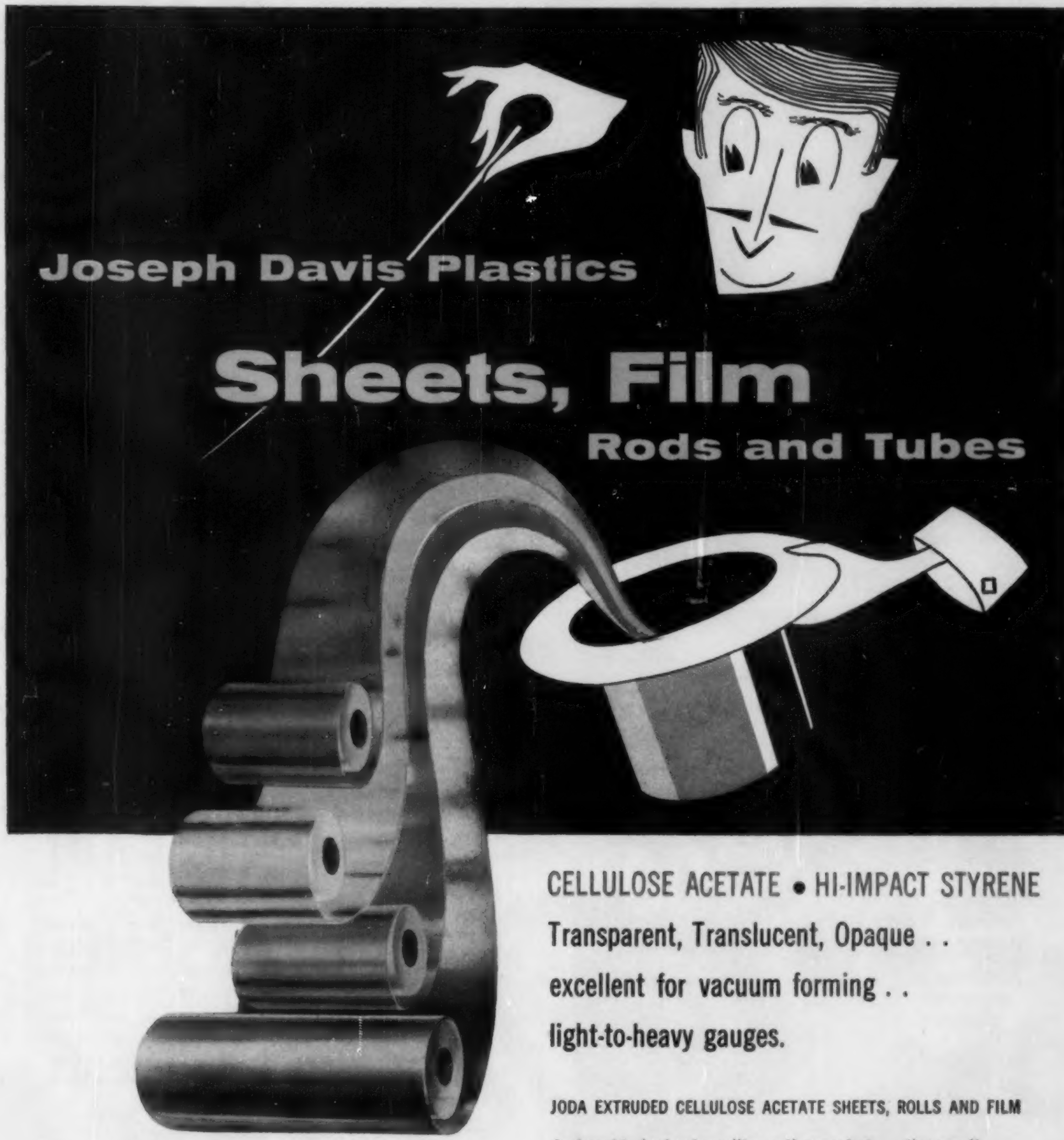

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Thermal distortion

(*From pp. 169–178*)

in part characterized by a high heat-distortion temperature and a low processing temperature and these limitations delineate its thermal distortion curve.

The S-shaped curve obtained with polyvinyl chloride (Fig. 5) might be explained as an exaggerated case of the competing processes suggested for the cast polymethyl methacrylate, or it might represent a manifestation of elastic memory, the memory processes having different temperature dependences. Again, the possibility of crystallization can probably be ruled out since it is known that polyvinyl chloride is essentially noncrystalline (3).

Detailed examination of the flexural curve and the tensile curve at 66 p.s.i. for cellulose acetate butyrate (Fig. 6) revealed that they agree closely on the basis of maximum fiber strain versus temperature. That is, a deflection of 3.5 units on the flexural curve corresponds in strain to a deflection of 1 unit on the tensile curve. In the flexural test, the specimen at 91° C. has undergone a deflection equal to that specified for the A.S.T.M. heat-distortion temperature, which corresponds to a maximum fiber strain of 0.0019 in. per inch. From the 66 p.s.i. tensile curve in Fig. 6, the distortion corresponding to this strain occurs at 93° C. The A.S.T.M. heat-distortion temperature is about 97° C. for this plasticized acetate butyrate.

The curves of Fig. 7 show that, for these particular moldings, any residual molding stresses were low, at least below 55 p.s.i. The approximate temperature for onset of crystallization for this material is clearly indicated in curve 1, and curve 2 shows the considerable stabilizing effect towards thermal distortion caused by partial crystallization conferred by the heat treatment. Density measurements in a density-gradient tube (2) gave a value for the heat-treated sample higher by about 0.022 g./cc. than that of the as-molded sample, thus confirming that the heat treatment effected some crystallization (4, 5).

These tensile-distortion tests likewise convey important information concerning thermal behavior of films and yarns, that is, amount of orientation and onset of crystallization, as well as indicating the resistance to elevated temperature deformation. Thus, the curves of Fig. 8 show the thermal-distortion behavior of films of a crystallizable polymer as a function of processing. Curve 1 yields a 2% distortion temperature of 93° C. for the as-extruded film at 55 p.s.i. initial stress and shows that a low stress must be used to indicate onset of crystallization; otherwise the specimen rapidly elongates off scale. Curve 2 was accordingly run at 10 p.s.i. and shows crystallization beginning at about 105° C. X-ray diffraction photographs and density measurements confirmed the fact that heat treatment at temperatures above this value produced crystallinity in amorphous samples of these films;

orienting of the film by hot stretching without an additional crystallization treatment caused excessive shrinkage, as shown in curve 3, with a lowering of the 2% distortion temperature to 86° C. If a hot-stretched specimen is crystallized by a high-temperature heat treatment, shrinkage still occurs (curve 4), but 2% distortion does not take place below 203° C. Density measurements gave a value about 0.02 g./cc. higher for specimen 4 than for 3, indicating considerable crystallinity in the former.

Figure 9 is included to indicate versatility of the apparatus, since thermal-distortion behavior of yarns can thus be followed. Progressive severity of heat treatment for these three drafted yarns caused a progressive increase in temperature at which shrinkage occurred.

The autographic heat-distortion apparatus described has proved to be a very useful tool for evaluating the heat-distortion properties of plastics and films, for studying the quality of the injection moldings used, for estimating the moldability of the plastic, and for indicating orientation and crystallizability of polymers.

Acknowledgment

The authors would like to acknowledge the important contributions of Mr. W. B. Chapman to the design and fabrication of the apparatus and to thank Mr. R. M. Schulken, Jr., for many helpful suggestions and discussions.

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The Plastiscope

News and interpretations of the news

By R. L. Van Boskirk

Section 2 *(Section 1 starts on p. 49)*

Cresylic acid plant

Full production by January 1957 is anticipated for the completely continuous processing plant for cresylic acids, cresols, and phenols now being built on the 48-acre Newark, N. J., headquarters site of Pitt-Consol Chemical Co., a subsidiary of Pittsburgh Consolidation Coal Co.

Start-up operations at the refinery, major unit of a $3.5 million plant investment, will begin late this year. The new refinery, which will employ a continuous extraction process, will triple Pitt-Consol's production of cresols, cresylic acids, phenol, phenolic resins, and molding powders. It is also said that it will enable the firm to make products of higher purity and more uniform quality than was possible by older batch-processing methods. Cresylic acids are used in a wide range of processes and products ranging from solvents and disinfectants to bonding resins and plasticizers.

The Newark facility will use as its raw materials petroleum refinery liquids which were formerly disposed of as waste.

A large refinery, which will produce substantially the same range of chemicals from liquids derived from low-temperature carbonization of coal, is planned for operation at Cresap, W. Va., by late 1958. Combined output of the Newark and Cresap refineries will total about 60 million lb. annually by 1960, according to the company.

Polyethylene exports

The astounding sales figures for polyethylene, running from 38 to 44 million lb. a month, have created considerable questioning in the industry. Probably much of that questioning came about because the inquirers were unaware that from 10 to 12 or 13 million lb. a month of the material was for export, with Japan one of the leading importers. Total export for 1956 may go over 135 million lb. if the Census Department figures are correctly interpreted. Total sales of all polyethylene in the United States are expected to reach somewhere near 500 million lb. in 1956 compared with 350 million in 1955. Exports were estimated at somewhere around 60 million lb. in 1955.

Expanded polyethylene

Now available from American Agile Corp., Maple Heights (Cleveland), Ohio, is foamed polyethylene designated Agilene-F. Offered in such semi-finished molded components as rings, blocks, rods, and sheet, the new material may be used for heat and electrical insulation, soundproofing applications, and various similar uses.

Unlike unexpanded branched polyethylene whose specific gravity is .92, Agilene-F has a specific gravity of .46, or where required, .33. The foam is unicellular, light in weight, and extremely buoyant; it has a tensile strength of 500 to 600 p.s.i. and good compressibility.

U/L approval for Phenolite

An arc- and flame-resistant grade of Phenolite, GP-9204, has been added to the line of polyester-glass mat laminates produced by National Vulcanized Fibre Co., Wilmington, Del. The laminate has the Underwriters' Laboratory approval as a flame-resistant material. It is approved for the sole support of current carrying parts at temperatures up to 150° C.

According to National, the dimensional stability and impact strength of GP-9204 suggests important uses in mechanical applications, such as supports, panels, and cams. Its electrical and flame resistance make it applicable for armature slot wedges, spacers, switchboard panels, switch insulators, and arc chutes.

GP-9204 is produced by impregnating fibrous glass mats with a liquid polyester resin containing inorganic fillers and a catalyst. These treated mats are then heat cured under low pressure to produce a hard laminate. The material is available in three sizes: 32 by 36 in.; 32 by 48 in.; and 32 by 74 inches.

New foam source

Flexible polyurethane foam for cushioning, padding, insulation, decoration, and other industrial purposes is now available from Texas Foamed Plastics Corp., Gonzales, Texas. The services of a production laboratory for assistance in design and engineering are also offered.

Manufactured under a Du Pont license and designated Gemfoam, the material can be supplied in rolls, sheets, or slabs in thicknesses from ⅛ to 12 in., and widths up to 48 inches. The line includes 10 resiliencies, from very soft to very firm in any shade of seven basic colors.

Unplasticized vinyl film

Now available from Ferplex Chemical Co., 500 Fifth Ave., New York, N. Y., representative for Rheinische Gummi und Celluloid-Fabrik, Mannheim - Neckarau, Germany, is unplasticized vinyl film in thicknesses from 1 to more than 20 mils. Tradenamed Nicotherm, the material is colorless and highly transparent—not as transparent as cellophane but more so than the usual polyethylene film. It is 24 in. wide for the thin gage and up to 35 in. for heavier gages. The price is in the 80¢ per lb. range, duty-paid.

Nicotherm vinyl is continuous-calender-polished and can be obtained oriented or unoriented. The oriented has tensile strength of

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The Plastiscope

18,000 p.s.i. in one direction as compared to unoriented at 8000. The unoriented shrinks only 3 or 4%; the oriented shrinks 40% after heating at 100° F., which makes it useful for insulation because the shrinkage helps it to "grab hold." The heat resistance for both oriented and unoriented is about 175° F.

The material is suggested for vacuum forming, food wrapping, industrial tapes, and sound recording.

New ad. manager

Burton W. Gussow has been appointed advertising manager of Modern Plastics and *Modern Packaging* Magazines. Mr. Gussow, a graduate of New York University, has served on the sales staffs of both publications since 1945. Before coming to Breskin Publications, he was a market researcher at the American Institute of Public Opinion and an economics instructor in New York City secondary schools.

3M adds new film

Clear polyester film, tradenamed Scotchpak B, has been introduced by Minnesota Mining & Mfg. Co., St. Paul, Minn. The film is heat-sealable on both sides, enabling it to be combined into tubular form. 3M's original polyester film, Scotchpak A, announced recently as a new entry into the flexible film industry, is heat-sealable only on one side.

Boom in boats

Glass-reinforced polyester boats —unknown only 10 years ago—have shown such phenomenal growth that they are now being produced at a rate of about 40,000 per year. Taking cognizance of the impact of reinforced plastics boats, *Sports Illustrated*, in its second anniversary issue, devoted several feature pages to them. Tracing the development of the plastic hull from the first sisal-polyester 10-ft. dinghy to the latest Coast Guard 40-ft. glass-reinforced polyester patrol boat, *Sports Illustrated* concludes: "With advancing research and the gradual elimination of substandard builders, the future of the (polyester-) glass boat appears unlimited."

S.P.E. meeting—January 16-18

"Fifteen Years of Plastics Progress" is the theme of the forthcoming 13th Annual National Technical Conference which will be presented by the Society of Plastics Engineers, Inc. at Hotel Sheraton-Jefferson, St. Louis, Mo.

According to Otto Wulfert, Wagner Electric Corp., general chairman of the St. Louis Section Conference Committee, a major share of the work on the Conference program has been completed. Included among the subjects of the technical sessions will be: tooling and machinery; atomic possibilities; design; foams; injection, extrusion, and compression molding developments; polyethylene; and epoxies.

Information for registration may be directed to the registration chairman, Harold A. Holz, Bakelite Co., 122 N. Kirkwood Rd., Kirkwood, Mo. Individual registration fee for S.P.E. members is $10.00; non-member fee is $15.00.

Ferro adds pigments

New reduced cadmium pigments, called Cadmopone, have been developed by Ferro Corp.'s Color Div., 4150 E. 56th St., Cleveland, Ohio. Available in medium red, orange red, and orange, the pigments are claimed to be permanent. non-bleeding, non-fading, and resistant to heat, light, acids, and alkalies. They disperse readily in thermoplastics.

3D fabric

Taking advantage of differential shrinkage properties of two types of saran filament, Lumite Div., Chicopee Mills, Inc., 40 Worth St., New York, N. Y., is now manufacturing three-dimensional fabrics for use in automobile upholstery, seat covers, outdoor and office furniture, and the like.

Designated Lum-Puf, the fabric is produced by weaving high-shrinkage with normal saran and exposing the fabric to controlled dry heat. The resulting differential shrinkage produces sharply accentuated puffs in the fabric and a three-dimensional effect. These puffs remain throughout the normal life of the fabric. Structure and process patents on Lum-Puf have been granted to the company.

Another three-dimensional fabric, produced by weaving polyethylene filaments with fibers having lower shrinkage values, was reported in Modern Plastics *33*, 226, April 1956.

Reichhold research center

An elaborate research laboratory, named Plasticenter, has been dedicated at Elizabeth, N.J., by Reichhold Chemicals, Inc. as a step in expansion of its technical service to customers and to develop basic information on RCI's surface coating resins and plastic materials. The main purpose of the Plasticenter is to test under simulated end-use conditions products made with the company's materials.

General Hull's crystal ball

At the recent 130th meeting of the American Chemical Society, Gen. J. E. Hull, president of the Manufacturing Chemists' Association, Inc., made several interesting comments on the outlook for the plastics industry in his address "Tomorrow's Responsibility." He pointed out that some 4 billion lb. of synthetic fibers will be required by 1975. Over the past five years, there has been a significant increase in the use of plastics in shelter, from panels and ducts to flooring and sink tops. These new uses present a new responsibility.

Today, M.C.A. has underway a project in cooperation with the Society of the Plastics Industry which will probably have a revolutionary effect on building codes as far as the use of plastics products is concerned. But the industry, said Gen. Hull, is faced with

The Plastiscope

the responsibility of making sure in every way possible that recommendations regarding the use of plastics in building do not in any way sacrifice safety for sales.

Perhaps the greatest responsibility of all for the chemical industry, continued the General, is that of making sure there will be a sufficient number of qualified people to run the industrial machine of tomorrow. An M.C.A. study shows that based on projected industrial expansion and past and probable future graduations in science and engineering, the United States will be short 457,000 scientists and engineers by 1965. The chemical industry alone would be short some 93,000.

Through the M.C.A., the chemical industry recently took another small step in helping solve this enormous problem by launching a $1 million, five-year, science education program aimed at interesting more young men and women in science as a career. Gen. Hull believes that the technical manpower problem will be solved, but that developing more interest in tomorrow's generation is certainly near the top of the list in considering the new, grave responsibilities of the chemical industry.

Koppers dedicates development laboratory

A laboratory to provide facilities for working out problems of its customers has been dedicated by Koppers Co., Inc. at its Kobuta, Pa., plant. The laboratory will also be devoted to the development of plastics and chemicals for commercial use.

The facility houses pipe and film extruders, paper laminator, 70-ft. long paper coater, sheet extruder, wire coater, several commercial injection molding machines, and a large range of testing equipment.

The new Development Laboratory is under the direction of B. R. Sarchet, formerly manager of the Kobuta plant and now development manager for the company's Chemical Div. About 200 persons, mostly scientists and technicians, are on the Development Laboratory's staff.

In-situ epoxidation

A new process for in-situ epoxidation with cation exchange resin catalysts has been developed by Becco Chemical Div., Food Machinery & Chemical Corp., Buffalo, N. Y. The process represents a substantial improvement over previous ion-exchange techniques and, according to Becco, makes practical for the first time continuous flow column techniques. Heretofore, all procedures employing ion-exchange resins have had one serious drawback: the resin was attacked by the oxidizing medium, resulting in short resin life, handling difficulties, and lowered reaction efficiency.

The new Becco process overcomes resin attack, thus substantially extending the working life of the resin as well as retaining its catalytic action.

Broadens field

Recently formed as a prime source of special monomers and polymers used in the dental plastics field, Specialty Resins, Inc., 32nd and Spring Garden Sts., Philadelphia, Pa.. has announced its intention of broadening its sales efforts in the direction of custom monomers and polymers for industry.

The first materials to be made available are allyl methacrylate (SR201) and ethylene dimethacrylate (SR202), widely used as cross-linking agents to increase heat and abrasion resistance and minimize crazing of plastics.

Teflon, Rulon now bondable

Bonding of Teflon and Rulon to other materials is made possible by a new method of surface treating developed by Dixon Corp., Bristol, Conn. Rulon is a modified Teflon also developed by Dixon. This type of material is notable for the difficulty involved in bonding it to itself or to other materials. The Dixon surface treatment is designed to alleviate that difficulty. Treated films, rods, sheets, and any extruded or molded shapes are available. Either part or all of any surface can be treated, making it possible for one portion to be bonded while the rest retains its non-adhesive properties.

A typical application for this technique is the production of bearings. Solid Rulon bearings have high resistance to wear and, within their load range, can be run indefinitely without lubrication. However, they are expensive. Now use of a thin film of surface-treated Rulon cemented to a metal bearing core is practicable; it not only reduces costs but also increases the range of loads and speeds for which the bearing may be used. Thinness of the Rulon film is said to speed up heat transfer to the adjacent metal, permitting the bearing to run much cooler.

Makes foam release easier

Intended for use in the manufacture of polyurethane foam, Patapar releasing parchments, made by Paterson Parchment Paper Co., Bristol, Pa., can be used effectively as liners for molding trays. According to the firm, the liners peel off easily and are said to eliminate surface pitting of the foam and to produce a smooth satin finish.

The releasing parchments have also found application in processes involving polyesters, vinyls, acrylics, and other materials.

Copper coating for non-conductors

A colloidal dispersion of metallic copper in a lacquer solution, "dag" Dispersion No. 235, provides a highly conductive surface coating to non-conductors. The new dispersion, offered by Acheson Colloids Co., Port Huron, Mich., is suggested for printed circuitry, electroplating of nonconductors, and for application on components of radar equipment, hearing aids, and electronic measuring devices.

The copper dispersion is said to be cheaper than other coatings such as silver paint. It is claimed

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HUDSON RED LIGHT
IN VINYL PLASTICS AND RUBBER

Excellent ease of dispersion
Excellent heat resistance
Excellent resistance to migration and crocking
Non-bleeding in water, dioctylphthalate, tricresyl phosphate
Fair to good fastness to light

HUDSON RED LIGHT
IN LITHOGRAPHIC, TYPOGRAPHIC, INTAGLIO INKS (TIN PRINTING AND FOOD WRAPPERS)

Excellent softness of grinding
Good baking resistance
Non-bleeding in brine, hydrocarbon solvents, alcohol
Resistant to bleeding in paraffin, fats, greases
Fair resistance to soap
Good fastness to light in fullshade and tint

HUDSON RED LIGHT
IN PAINTS

Excellent ease of dispersion
Non-bleeding in linseed oil and mineral spirits
Excellent resistance to acid
Fair resistance to alkali
Good fastness to light

We invite you to investigate the advantages of Hudson Red Light over competitive products—such as softness in grinding and fastness to light. In addition to its high tinctorial value, Hudson Red Light passes 100% through a 325 mesh sieve.

Make a practical plant trial of the dependability of Hudson Red Light for your own uses. Kindly call upon the services of our Technical Department—or our nearest sales office.

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The Plastiscope

to be more easily applied than copper foil which, in the production of printed circuits, for example, has to be laminated onto the plastic base and then etched away after the circuit has been printed. Application of Dispersion No. 235 may be by spray or brush.

Teflon for pipe, tubing, rods

Teflon pipe and tubing and Teflon-lined steel pipe are now being produced by Haveg Industries, Inc., Wilmington, Del. Pipe is being made in sizes up to 4-in. diameter; lined pipe in 2-in. sizes. The material is also available in rods and special machine parts.

The pipe, tubing, and rods and Teflon-lined steel pipe can be cut to desired lengths in the field and readily flanged. Besides its many electrical applications, this fluorocarbon tubing is recommended for use with steam or corrosive fluids and chemicals at high temperatures and pressures.

Impact material added to line

An improved grade of high-impact polystyrene material for injection molding and extrusion is now being offered by Kleestron, Ltd., W. Halkin St., Belgrave Sq., London, S.W.1, England. Designated Super 44, it is said to have double the strength of any previous material made by Kleestron. According to the company, Super 44 has improved flexibility and resistance to shock; allows molding in thinner sections with fewer supporting ribs; and permits undercuts and deep draws.

Kleestron is also offering sheet extruded from Super 44 for vacuum forming. The material is available in 48-in. widths, lengths up to 96 in., and 0.015- to 0.250-in. thicknesses.

O-Cel-O to make urethane foam

Automatic facilities for the production of Plastifoam polyurethane have been installed by O-Cel-O Div., General Mills, Inc., at its Buffalo, N. Y., plant. The foam-making device, called the Plastifoamer, developed by O-Cel-O, is capable of performing more than 100 individual mixing operations automatically, providing complete control of porosity, density, and color. Anytime the mixture is incorrect, the machine automatically stops.

The device involves more than 4000 ft. of control tubing. Within two minutes from the time the operator turns on the starting switch, the machine meters and mixes several liquids which then form the Plastifoam in a matter of seconds. The O-Cel-O unit has a capacity close to 10 million lb. annually.

Polyethylene-surfaced cellophane tape

Transparent pressure-sensitive tape having a special polyethylene-surfaced cellulosic backing has been developed by General Tape Corp., St. Paul, Minn. Designated Tape #66, the new product will be initially available to business and industrial users in ½ in. wide rolls, 2592 in. in length.

The polyethylene surfacing on the tape backing is said to largely overcome the tendency towards accidental breakage of conventional cellophane tape. The adhesive of the tape is of a crystal-clear resinous material, said to have good aging properties. The top surface of the tape itself is reportedly resistant to acids and alkalies and impermeable to greases, oils, and powders. It has dimensional stability with flexibility at low temperatures.

Radiation service offered

Manufacturers and processors of plastics materials will be able, in the near future, to make use of an irradiation pilot plant to evaluate atomic radiation in relation to their processes and products. The irradiation pilot plant (to be completed in 1957) is being established by Isotope Products, Buffalo, N. Y., as the second of three phases of a process radiation service. The other two are professional consultation and technical assistance in planning experimental programs (now operative); and (later) the design and construction of individual commercial units for production line irradiation techniques. (For discussions of applications of radiation in plastics, see MODERN PLASTICS 32, March 1955.)

New management at Bridgeport

Election of Lancaster P. Clark as its new president, succeeding James S. Berthold who resigned, has been announced by Bridgeport Moulded Products, Inc., Fairfield, Conn. Other officers elected with Mr. Clark were Dan R. Neary, vice president; Edward A. Tyler, vice president and secretary; and D. Earl Fleming, treasurer. These officers, together with John J. Bundshuh, constitute the board of directors.

Bridgeport Moulded, formed in 1934, with Messrs. Clark and Fleming among the original founders, is a major plastics custom molder and also manufactures a line of housewares under the name of Sparkle-Ware. The firm employs over 300 people in a manufacturing facility comprising over 80,000 sq. ft. of floor space.

New type acrylic thickeners

High-solids acrylic thickeners and dispersants for aqueous systems offer reduced shipping costs and simplified handling by conversion to a dilute, viscous salt at the point of use. The thickeners are produced by Rohm & Haas Co., Philadelphia, Pa., and designated Acrysol ASE-75 and ASE-60.

ASE-75 is expected to find applications in the manufacture of paints, inks, adhesives, paper coatings, textile backings, floor finishes, grinding compounds, and other applications where dry powders or low-solids thickeners are now used.

Areas in which polyacrylates are now employed and where Acrysol ASE-75 is expected to offer advantages include: Paints—for adjustment in viscosity of latex and emulsion compounds, including rubber latex paint, polyvinyl chloride latex, and

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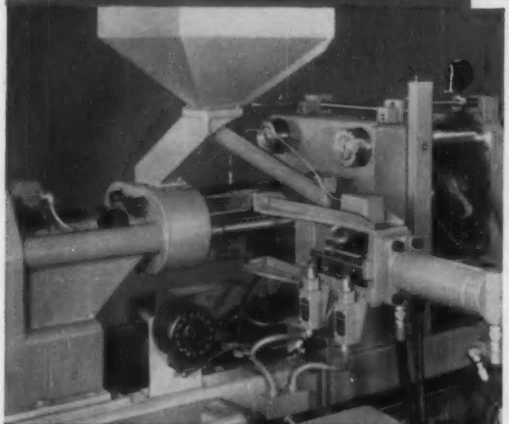
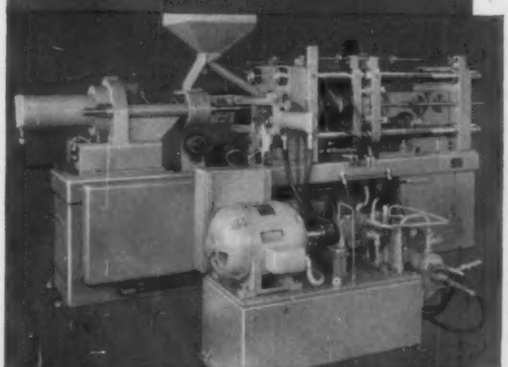
EXCLUSIVE NEW PRE-PLASTICIZER

GIVES THE LEWIS "6P" OUTSTANDING CAPACITIES!



Lewis-designed pre-plasticizer provides accurate temperature control . . . assures uniform material viscosity . . . permits lower injection pressures.



Separate hydraulic power plant for pre-plasticizer stuffer unit can be installed adjacent to machine or in remote location.

COMPLETELY NEW CONCEPT FEATURED BY FIRST PRE-PLASTICIZER DESIGNED ESPECIALLY FOR AN 8-OUNCE MACHINE

It's the talk of the trade . . . the new LEWIS 616-PP-12! Offering exclusive operating advantages, it is the first production machine capable of molding the new low-pressure linear-type polyethylene. It scores another "first" by coupling a new type pre-plasticizer with the famous "Hydra-Lock" clamp . . . an unbeatable combination for volume production of large precision moldings.

Pre-plasticizer's design permits use of injection pressures 60% to 70% lower than conventional pressures. And . . . pressure holding after injection is eliminated by a new nozzle shut-off valve. In addition, because heating chamber temperatures average only 45° F. higher than material's temperature when ejected, *the machine's normal cycle can be interrupted indefinitely without burning the material or changing its viscosity.*

These are only a few exclusive LEWIS "6P" features. Write for BULLETIN 106 . . . or call KEnmore 1-3040 . . . for specifications and prices.

LEWIS 616-PP-12 CAPACITIES

DRY CYCLE (strokes/hour)	360
OUNCES/SHOT (polystyrene)	22
CUBIC INCHES/SHOT (maximum)	36
PLASTICIZING CAPACITY (lbs./hour)	145
MOLD CLAMPING PRESSURE (tons)	200
PRESSURE ON MATERIAL (p.s.i.)	25,000

LEWIS

THE LEWIS WELDING & ENGINEERING CORP.
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23002 St. Clair Avenue • Cleveland 17, Ohio

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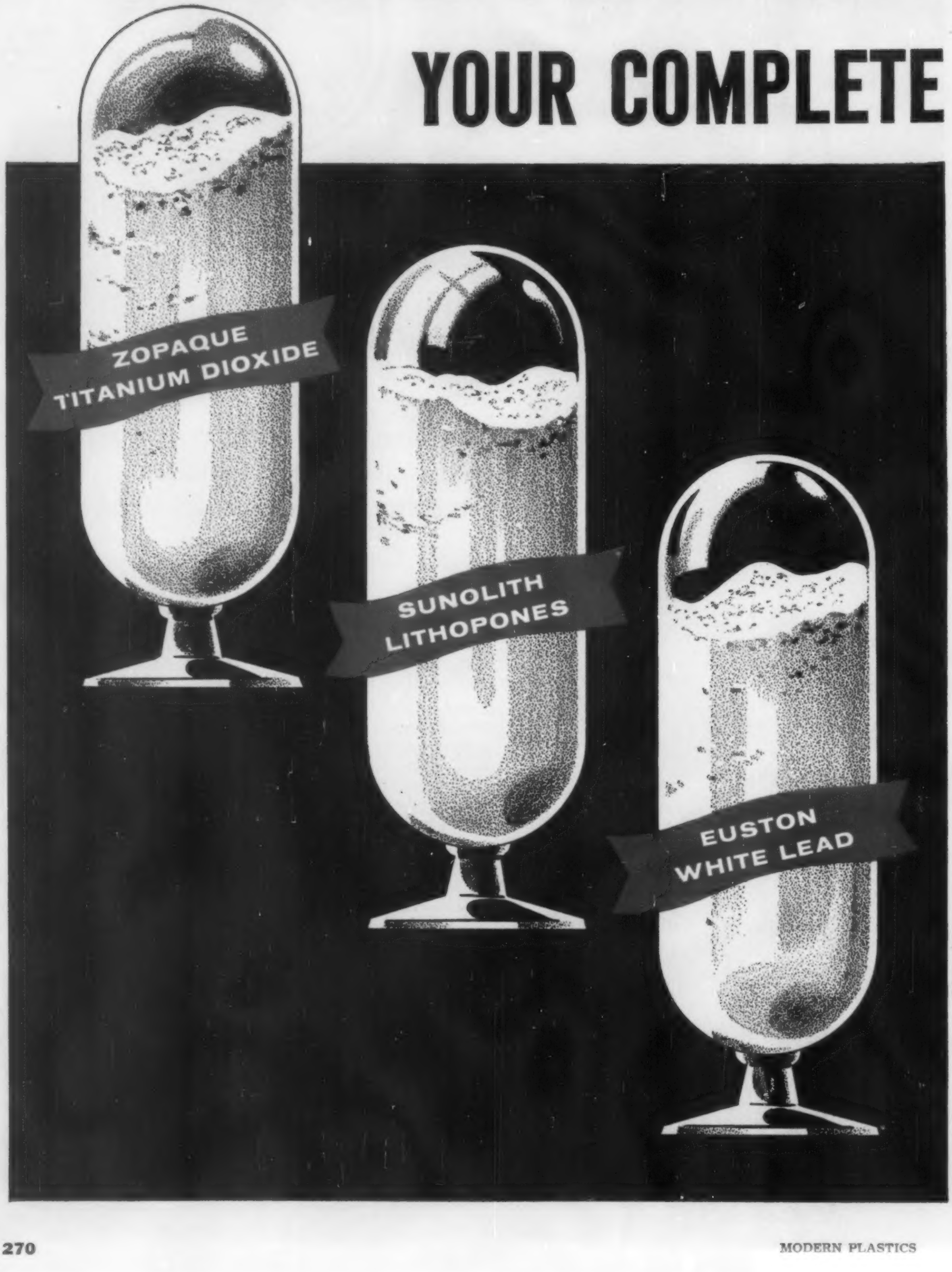

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WHITE PIGMENT NEEDS!

One source can meet your complete white pigment requirements. Specify Glidden, supplier of these pigments to industry: ZOPAQUE Titanium Dioxide, SUNOLITH Lithopones and EUSTON White Lead. These three pigments meet practically all formulations for plastic, paint, rubber, paper and ceramic products. Continuing Glidden expansion and modernization now make it possible to produce greater supplies of pigments than ever before!

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METALS DIVISION

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HAMMOND, INDIANA
SCRANTON, PENNSYLVANIA

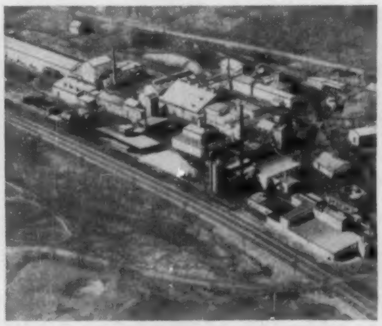
ZOPAQUE TITANIUM DIOXIDE

Production doubled; further expansion underway

The new Adrian Joyce Works, Baltimore, means doubled production of ZOPAQUE—the whitest white pigment obtainable. In ZOPAQUE, Glidden research has achieved greater whiteness and an accelerated dispersion rate plus outstanding gloss and color retention, low reactivity. Rutile and Anatase grades.

SUNOLITH LITHOPONES

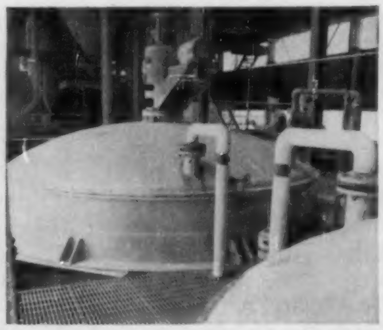
Modernized plant facilities increase efficiency



Improved facilities and processing efficiency at its Collinsville, Illinois plant, enable Glidden to meet the steady demand for SUNOLITH Lithopones . . . available in a wide range of grades, including Titanolith (titanated lithopone) with higher hiding value than regular lithopones.

EUSTON WHITE LEAD

Highest quality basic lead carbonate available



Continuous research and development at Euston Lead Division, Scranton, Pennsylvania, produce white lead of highest purity and quality. EUSTON White Lead has lower oil absorption than other white pigments. Finer, more uniform particles assure rapid solution, exceptional suspension. Various grades.

acrylic emulsion paints; textiles—as a thickener in the rubber latex coating and backing of fabrics; rubber—as a clear, removable coating for rubber goods; adhesives—as a viscosity control agent and adhesion promoter for synthetic and natural latex adhesives, or as a substitute for remoistenable adhesives; ceramics—as a temporary binder in molding, glazing, extrusion, and jiggering; polishes—as a suspending agent for abrasives in liquid polishes, and as a substitute for alkali-soluble hard resins in floor polishes; paper—as a thickener for coating resins in paper manufacture; inks—as a suspending agent for pigments in inks and other aqueous pigment dispersions; petroleum drilling—as an additive to upgrade local clays and to reduce water loss in drilling fluids.

More cementable Teflon tape

Latest entrant to the group of manufacturers producing bondable Teflon tape is Enflo Corp., Pennsauken, N. J. The firm offers tape in thicknesses from 0.0005 to 0.060 in. and in widths from ½ to 12 inches.

Either or both surfaces of the tape are treated by an undisclosed process, which makes the Teflon bondable to plastics, glass, steel, aluminum, or practically any other material including Teflon itself, using epoxy resin adhesives.

Improved tubing

Modifications of its Hyflex and Transflex electrical tubings have been announced by Irvington Div., Minnesota Mining & Mfg. Co., Irvington, N. J., rounding out a line of tubing meeting all requirements of MIL-I-631C.

The modified formulations give fungus resistance without impairing flame resistance or clarity. According to Irvington, the tubing is approved for both Class I and Class II (fungus resistance) in both Grade A and Grade B (general and low temperature) as well as for Categories 1 and 2 (self-extinguishing) for both temperature grades.

The improved vinyl tubings are available in both clear (Transflex) and colors (Hyflex). Lengths of 500 and 1000 ft. are furnished on spools and 50- to 100-ft. lengths are available in coils. Tubing sizes available range from No. 24 to 2 inches.

New plastics degree program

Another engineering school has increased its facilities for educating young men in plastics techniques. Lowell Technological Institute, Lowell, Mass., announces that it will award associate degrees in plastics engineering in its evening division, commencing with the current fall term which started on September 24.

The plastics curriculum includes courses in chemistry, physics, algebra, calculus, polymer chemistry, plastics technology, and others. Duration of the complete course is five years (two semesters per year) of approximately seven class hours per week per semester.

Registration for the spring term starts January 15, 1957.

"Preconditioned" silicone rubber

A new series of vinyl-silicone rubber compounds said to meet the toughest aeronautical specifications for high-temperature applications has been announced by Silicones Div., Union Carbide and Carbon Corp. They are marketed as K-1044R, K-1045R, K-1046R, K-1047R, and K-1048R silicone rubber compounds.

According to Union Carbide, these rubbers have controlled reactivity, high tear, high elongation, tensile strength of over 800 p.s.i., low compression set, good oil resistance, low moisture absorption, and good dielectric properties. They are "preconditioned" to permit easy processing by fabricators.

With the introduction of this series, the rubber fabricator can now buy one compound which meets the Aeronautical Materials (AMS), the joint military rubber (Mil-R), and American Society for Testing Materials (A.S.T.M.) specifications in the appropriate hardness. K-1040's also have civilian uses such as in home appliances.

New vinyl upholstery

Nylon jersey-backed vinyl is now being offered to the upholstery trade by Bolta Products Div., The General Tire & Rubber Co., Lawrence, Mass. The material, designated Bolta Continental, is guaranteed by the company against tearing and ripping where approved methods of application have been followed. According to Bolta, the material is easy to tailor; can be pulled taut without wrinkling, sagging, or reducing its serviceability; and has complete recovery after repeated stretchings.

A special lamination process bonds the face sheet and backing without weakening either material. Bolta Continental is available in a range of colors.

Now—silcone foam rubber

Heretofore available only as solids and pastes, silicone rubbers are now also being furnished as foams by The Connecticut Hard Rubber Co., 407 East St., New Haven, Conn. Called Cohrfoam, the new material is said to be light in weight and to remain soft and resilient over a temperature range of −100 to 480° F. It can be molded into complex shapes and has already found application as airframe seals where no other material has operated successfully.

Initially, Cohrfoam is being offered in sheet form and custom moldings up to 8 in. thick. Anticipated uses include acoustic and vibration packing, electrical and thermal insulation, and mechanical sealing where a large, extremely light seal is needed.

Precision Teflon extrusions

High-density Teflon extruded shapes can now be produced faster and in a wider range of dimensions on a newly designed extruder, according to Tri-Point Mfg. & Developing Co., Brooklyn,

"RCI takes own medicine*...and likes it!"

***Entire exterior and interior and all structural members** of this Strick insulated trailer van are made of Reichhold's own POLYLITE polyester resin reinforced with fibrous glass

Strick PLASTIC TRAILERS...

prescription for greater payloads!

• The POLYLITE plastic trailer you see here weighs 2000 pounds less than a comparable van made of aluminum...and 3500 pounds less than one of steel. In terms of payload, *that ain't hay!* It permits vans with up to 15% more cube, too.

For added durability and easy cleaning the interior of the van is also fabricated with tough POLYLITE resin. (Three inches of fibrous glass insulation separate the plastic exterior from the POLYLITE interior.) Attractive, permanent color was incorporated in the reinforced plastic sides and top of the 32-foot van at the time of fabrication.

At RCI we've had three of these trailers built for us by Strick Co., Philadelphia, a pioneer in this application of POLYLITE.

In small parts or something as big as this trailer, POLYLITE construction can offer *you* advantages, too. Do you want lightweight strength? Durability? Easy maintenance? Write to RCI about POLYLITE for your products. And ask for *Booklet A*.

REICHHOLD

Synthetic Resins • Chemical Colors • Industrial Adhesives • Plasticizers
Phenol • Formaldehyde • Glycerine • Phthalic Anhydride • Maleic Anhydride
Sodium Sulfite • Pentaerythritol • Pentachlorophenol • Sulfuric Acid

REICHHOLD CHEMICALS, INC.
RCI BUILDING, WHITE PLAINS, N. Y.

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N. Y., custom extruder and developer of the new equipment. Teflon must be formed under high pressures to provide necessary compacting, fusion, and evolution of the extruded form. Through the use of the new equipment, Tri-Point is able to offer extrusions with a minimum of orientation and weak spots.

Advances represented by the new equipment center around better die design and take-off controls. These have made possible improvements in surface characteristics of stock so that extruded sections now have a higher degree of precision.

Flexible epoxy available

Now available from Jones-Dabney Co., Louisville, Ky., is Epi-Rez 507, a clear, pale, low-viscosity epoxy resin developed specifically to fill the growing need for flexible epoxy compositions. Combined with Epi-Rez 510 in various proportions, and an anhydride for curing, almost any degree of hardness is said to be obtainable in the cured compound. The cured resins range from tough, flexible products to hard, high-impact resistant materials.

In general, these mixtures are cured at temperatures of 200 to 300° F. The reaction is slow and the mixture has a long pot life and cures with a very low exotherm. By the use of an accelerator, it is possible to obtain a wide range of stability and speed of cure.

Middle-South news

The middle-south area, consisting of the states of Louisiana, Mississippi, and Arkansas, is developing an economy of considerable interest to the plastics industry. Among the latest plants announced in that section are a vinyl chloride monomer plant by Ethyl Corp. at Baton Rouge, La., to be completed in 1957, adjacent to the company's anti-knock compound facilities; a new $500,000 plant for production of flake board, used as core material for veneers and laminates, by United Wood Corp. at West Memphis, Ark.; and a methanol plant at Sterlington, La., by Commercial Solvents Corp.

Plasticizer news

Secondary for vinyl. Low-cost Chlorowax LV, produced by Diamond Alkali Co., 300 Union Commerce Bldg., Cleveland, Ohio, and intended as a secondary plasticizer for vinyl compounds, is claimed to have low volatility, low migration rate, lack of odor and toxicity, light color, and low viscosity. It is recommended where maximum heat stability and good low-temperature torsional properties are important. The use of Chlorowax LV is also said to improve the flame resistance of a vinyl compound when it is substituted for flammable plasticizers.

DOP substitute. A low-cost phthalate ester designed to replace more expensive DOP in vinyl formulations is now available from Brown-Allen Chemicals, Inc., Staten Island, N.Y. Called Polycon #40, the product, according to the producer, is for use in vinyl flooring, welting, garden hose, and other extruded vinyls where color is only a minor factor; it is also suggested for coated fabrics, slush and dip moldings, and wire and cable covering.

The compound is claimed to have superior solvation to permit improved extrusion rates and to offer easy processing at high Durometer hardness. It can be extruded with relatively high amounts of low-cost extenders.

Pipe notes

American Hard Rubber adds polyethylene pipe. A new nontoxic, pressure-proved, general-purpose polyethylene pipe, approved by the National Sanitation Foundation for piping water and other fluids for human or animal consumption, has been announced by American Hard Rubber Co., 93 Worth St., New York, N. Y. Outstanding features of the polyethylene pipe are low cost, ease and speed of installation, and permanence.

Produced on special machinery at the firm's Supplex Div., the pipe has extremely smooth bore. This is said to reduce resistance to flow and to permit a pump to deliver a greater rate of flow at the well-head or through the distributing system.

Supplex is the ninth basic type of rubber and plastic piping materials now available from American Hard Rubber for industrial, farm, and home use. Others include Ace hard-rubber lined steel for high pressures, Tempron for high temperatures to 275° F., tough Ace-Ite general-purpose rubber-plastic blend, Riviclor PVC, Ace hard rubber, Parian (polyethylene) rigid Schedule 40 and 80 piping, saran pipe and tubing, and Ace-Flex flexible transparent tubing.

Plastic pipe group. Sales of plastic pipe to American homes, farms, and factories—$45 million in 1955—will reach $90 million by 1960, according to a forecast by John J. Halvorsen, manager of sales and development, Plastic Pipe Div., Orangeburg Mfg. Co., Inc., made at a recent meeting of the American Society of Sanitary Engineering. The industry's success to date is shown by a 900% growth from only $500,000 sales in 1948.

During the past year, according to Mr. Halvorsen, over 38 million lb. of polyethylene pipe were produced in this country and there are now more than a million water installations utilizing this type of pipe in American homes, farms, and factories.

Lighter weight PVC pipe. A new line of lightweight, thin-wall polyvinyl chloride pipe with a uniform pressure rating in all sizes has been introduced by Alloy Tube Div., The Carpenter

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The Plastiscope

Steel Co., Union, N.J. The series, known as Schedule PR-150, represents an addition to the firm's recently announced Schedule 40 and Schedule 80 pipe. Its generally thinner wall and larger inside diameter give it greater flow capacity than the older lines. There are two basic types in this new series. One has high chemical resistance and a maximum working pressure of 150 p.s.i. at 75° F. The other has high-impact strength and a rating of 125 p.s.i. at the same temperature.

The pipe is available in eight sizes ranging from ¼ to 4 inches. Wall thicknesses range between 0.50 and 0.230 inch. All pipe in the series is furnished in standard 10- and 20-ft. lengths with plain ends. A full line of socket solvent-cement fittings is available for use with the new PVC pipe. Threaded joints are not suitable with this line.

On an installed cost basis, Schedule PR-150 compares favorably with conventional threaded piping systems in iron or galvanized pipe. It also offers numerous advantages which can result in the reduction of maintenance and operating costs.

Among other uses, unplasticized polyvinyl chloride pipe produced by Carpenter has been found highly successful for handling muriatic acid in an eastern steel mill at as little as one sixth the cost of other corrosion resisting materials used for acid conveying lines in the same mill. It has proved easier and cheaper to install than either steel or rubber-lined pipe. It requires no welding or bolting and there are added savings in the originel cost of fittings.

This piping system starts at the terminal pit where incoming tank trucks pump acid into the storage tank inlet pipe. Compressed air forces the acid through the line at a steady pressure of 30 p.s.i. This 2-in. pipe goes underground to a depth of 3 ft. and, inside a 6-in. steel pipe, crosses under a 40-ft. wide roadway traveled by trucks and industrial locomotives. It rises out of the ground on the other side of the roadway and leads into the acid storage tank alongside the cleaning room.

All of the valves in the piping system are made entirely of PVC, except four which are diaphragm valves. In the case of these four valves, the bonnets and handwheels are made of steel, and the body of PVC. This type of construction makes it possible to remove the bonnet and replace a diaphragm without taking the valve from the line.

Franklin to specialize on pipe. Franklin Plastics, Inc., Products Div., Franklin, Pa., announces that it will henceforth concentrate on expansion of facilities for production of Dur-X plastic pipe and fittings and related products. The company will discontinue incompatible operations in its Plastic Wall Tile Div. and de-emphasizes its Custom Manufacturing Div.

Expansion

B. F. Goodrich Chemical Co. will construct a new $2.5 million plant at Calvert City, Ky., to manufacture specialty acrylic polymers. Uses for these polymers include textile sizes, binders for foundry core sand, flocculating agents, and additives for pharmaceutical, cosmetic, and latex paint formulations.

Construction will start immediately and is expected to be completed in October 1957. At that time 25 to 30 employees will be required to operate the new facilities. The new plant will bring the company's investment in plants and equipment at the Calvert City location to more than $17 million.

Bassons Industries Corp. has purchased a new plant in Yonkers, N.Y. Formerly part of the Alexander Smith Carpet Works, the new plant will afford 100,000 sq. ft. of straight-through manufacturing space on two levels. The Yonkers facility, to be called Plant Number 1, will house the firm's Reinforced Plastics Div. (all thermosetting products), Forming Div. (thermoplastic products), and Electronics Div. (electronic parts manufacturing and proprietary items).

The present plant, now designated Plant Number 2, will house the Wire and Cable Div. (plastic coating on wire and production of thermoplastic pipe), Pulp Molding Div. (products made from resins and paper, sisal, and other normally waste materials), and operations concerned with the basic formulating of resins.

Bassons also announces its entry into new products, particularly the **Raw Pulp Div.**, which will enable the company to turn out products made from resins plus paper, sisal, and other normally waste material. Such products as luggage, packaging for shipment of glass-containing liquids, various types of furniture including chair seats, tables, and desk tops, as well as industrial applications, are expected to evolve through this new process.

Bassons has also announced that it will build a high-pressure pipe plant in Texas for the manufacture of plastic-coated pipe and geophysical plastic wire, both used extensively by the petrochemical industry.

Reeves Bros., Inc. has enlarged its operations in the industrial plastics field by the acquisition of **Vi-Plax Products Corp.**, Beverly, N.J., and **Garrison Co.**, South Plainfield, N.J., both plastics extruders. Reeves is a textile manufacturer whose previous interest in the plastics field was centered around the production of extruded polyethylene filaments for use in industrial textiles, ropes, etc.

With the acquisition of the two companies, Reeves will now offer a line of products under the trademark Viplax which will include rigid PVC pipe and fittings: nylon rod, tubing, and film: nylon. fluorocarbon, polyethylene. and vinyl wire coatings; and

The Plastiscope

pressure-rated pipe and fittings for the gas and chemical industries which will be sold through Reeves' Vulcan Rubber Products Div.

John M. Fenlin, formerly a senior officer of Vi-Plax, becomes vice president and director of sales. **David H. Garrison**, formerly head of Garrison Co., is now vice president in charge of production.

The new subsidiary, to be known as the **Viplax Div.**, will be combined with Reeves' present polyethylene monofilament extrusion operations, formerly under the direction of **Dr. Victor L. Erlich**, who now becomes vice president and director of Viplax.

Reichhold Chemicals, Inc., White Plains, N.Y., has entered the field of basic petrochemicals through long-term contracts with **Escambia Chemical Corp.** Escambia presently is producing ammonia, nitric acid, and ammonium nitrate near Pensacola, Fla.; polyvinyl chloride resin will be on stream early in 1957.

Construction of a new plant near Pensacola has been started for the production of methanol and is expected to be in operation by early 1958.

Sylvania Electric Products, Inc., Parts Div., has purchased the Titusville, Pa., plant of **Ruel H. Smith Enterprises.** The 45,000-sq. ft. plant, located on a six-acre tract one and one-half miles north of Titusville, employs about 190 people. It has been operating on a sub-contract for Sylvania for six years and will now be known as the **Titusville Plastic Assembly Plant of the Parts Div.** Manufacturing superintendent of the facility, **Raymond J. Ledebur**, will continue in that post under the Sylvania operation.

Sylvania's new plastics plant in Warren, Pa., is nearing completion and is expected to be operating by the end of the year. The Titusville plant will work under the supervision of the new Warren facility, with the Warren plant producing plastics products and the Titusville plant assembling them. **Louis R. Wanner** will be plant manager of the combined operation.

Neo-Line Products Corp. announces plans for a new plant in Islip, N.Y., comprising 20,000 sq. ft. of working area. The company is expected to complete its relocation late in 1957.

The firm is a plastics custom molder and maintains its own tool and die shop. Present plans call for entry into the proprietary field with a line of housewares, toys, and other products. For the past year, Neo-Line has operated on a six-day week, 24-hr. day basis.

G. Felsenthal & Sons, Inc., Chicago, Ill., plastics fabricator and molder, has increased its injection molding production capacity by 10% with the installation of its 16th injection machine. Four more machines are expected to be added within a year.

Flightex Fabrics, Inc., 93 Worth St., New York, N.Y., has opened a new glass cloth finishing plant at Clifton, N.J. The new facility, under the management of **Carl Joseph**, will supply all the popular glass cloths, finishes, and treatments for the industrial trade.

Hexcel Products, Inc. has acquired about seven acres of land and 50,000 sq. ft. of factory space in Havre de Grace, Md. The company produces honeycomb structural core materials for aircraft and other industries.

Lunn Laminates, Inc. has opened another plant at Broadway, Huntington, N.Y. The plant covers 5000 sq. ft. of space and houses the molding, trimming, and finishing sections in addition to those in the main plant at Oakwood Rd. and West 11th St. The firm has also added sales offices at 55 W. 42nd St., New York, N.Y. Lunn produces consumer, industrial, and military products in reinforced plastics.

Durable Formed Products, Inc., 6 Greene St., New York, N.Y., has expanded its manufacturing facilities by the addition of the following equipment: one twin heavy-duty pneumatic double cylinder forming press with double acting 36-in. stroke cylinders and a bed capacity of 72 by 96 in.; one multi-drawer preforming gas-fired oven to handle sheet sizes of 36 by 48 in.; one extra heavy-duty 20-in. band saw; and a newly equipped tool room.

Chanal Plastics Corp. has added automatic equipment and expanded handling facilities at its plant at **361 Stagg St., Brooklyn,** N.Y. Concurrently, **Donald S. Freeman** has been named vice president in charge of industrial sales.

Chanal vacuum forms plastic displays, advertising signs, and contour packaging from acetate, butyrate, and polystyrene sheets up to 42 by 72 inches.

Plastic Mfg. Co., Inc., 12 West End Ave., New York, N.Y., maker of signs, displays, and formed letters, has added 12,000 sq. ft. of floor space to its plant. The firm has also installed a press capable of forming 10- by 10-ft. sheet.

Meetings

Plastics groups

December 4-5: The Society of the Plastics Industry, Inc., Seventh S.P.I. Film, Sheeting, and Coated Fabrics Division Conference, Commodore Hotel, New York, N.Y.

January 16-18, 1957: Society of Plastics Engineers, Inc., Thirteenth Annual National Technical Conference, Hotel Sheraton-Jefferson, St. Louis, Mo.

February 5-7, 1957: The Society of the Plastics Industry, Inc., Twelfth S.P.I. Reinforced Plas-

(To page 284)

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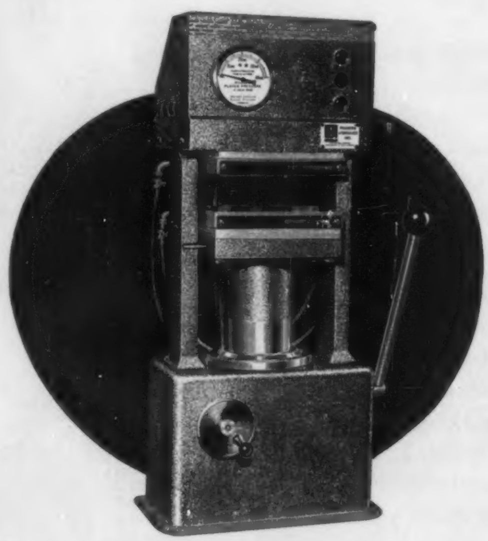

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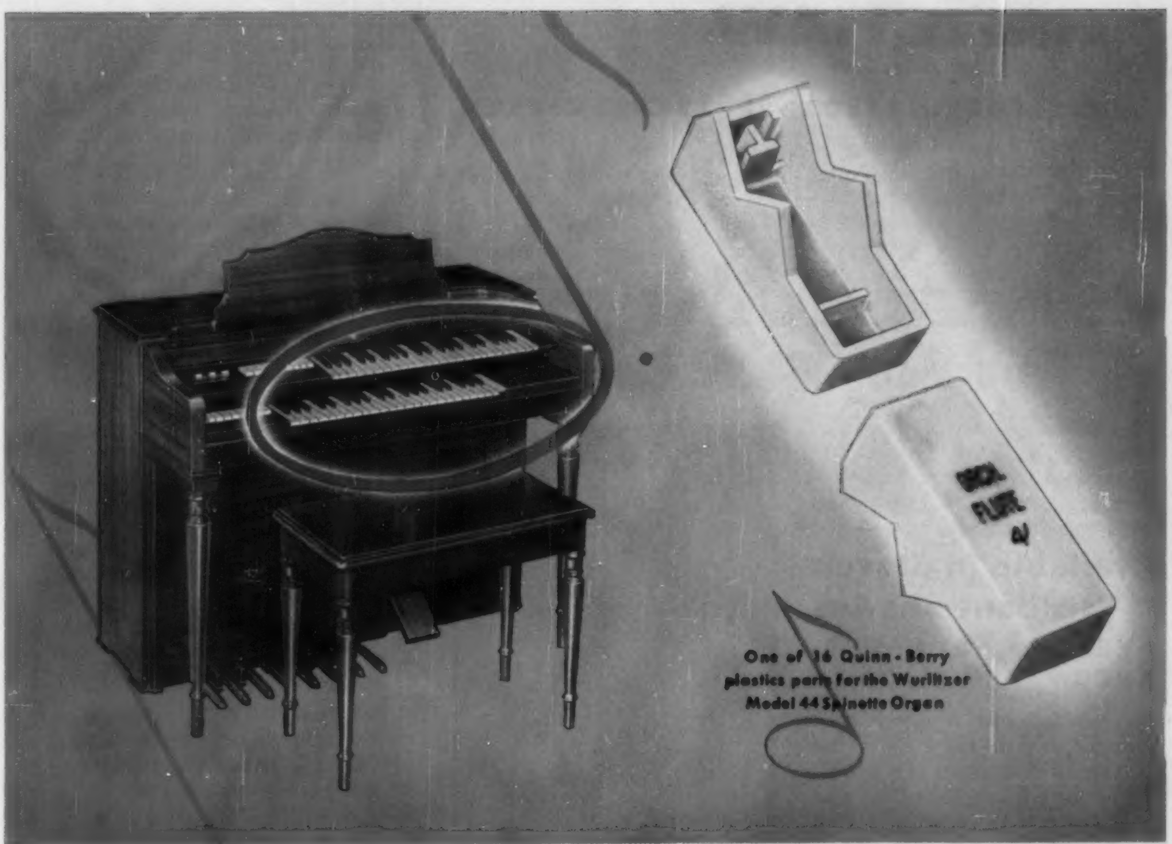

One of 16 Quinn-Berry plastics parts for the Wurlitzer Model 44 Spinette Organ

tics Division Conference, Edgewater Beach Hotel, Chicago, Ill.

March 18-21: The Society of the Plastics Industry, Inc., S.P.I. Annual National Conference, Los Angeles-Biltmore Hotel, Los Angeles, Calif.

March 18-21: The Society of the Plastics Industry, Inc., Pacific Coast Plastics Exposition, Shrine Exposition Hall, Los Angeles, Calif.

Other meetings

November 13-14: Chemical Market Research Association, Boston. Meeting to be held at Harvard Business School. Subject: "New Tools for Market Research."

November 22-December 3: Society of Industrial Chemistry, Assembly of Chemical Arts, including special session on Plastics Materials and Rubber, 28 rue Saint-Dominique, Paris 7, France.

November 27-30: American Chemical Society, Ninth National Chemical Exposition, Public Auditorium, Cleveland, Ohio.

December 2-4: Auto Trim Show, Hotel Sherman, Chicago, Ill.

December 4-6: Signal Corps Engineering Laboratories and the Wire and Cable Industry, Fifth Annual Symposium on "Technical Progress in Communication Wires and Cables," Berkeley-Carteret Hotel, Asbury Park, N.J.

December 7: University of Akron, Akron Polymer Lecture Group, Meeting, Knight Hall. Subject: "Catalyst Systems for the Production of Crystalline Polyethylenes."

December 9-12: American Institute of Chemical Engineers, Annual Meeting, Statler Hotel, Boston, Mass.

December 27: The Gordon Research Conferences, Twenty-fifth Anniversary Dinner, Commodore Hotel, New York, N. Y. Reservations $10, by application to Dr. W. George Parks, University of Rhode Island, Kingston, R. I.

January 17-24, 1957: Independent Housewares Exhibit, Inc., Ninth National Independent Housewares and Home Accessories Exhibit, Chicago, Ill.

Companies . . . People

William Brand & Co., Inc., Willimantic, Conn., merged with **Electric Insulation Corp.**, Fall River, Mass. The name William Brand & Co., Inc. will be retained for the operations of the combined organizations.

Earlier this year construction was started on a 33,000-sq. ft. addition to Brand's North Windham plant which produces Turbo plastic wires and cables, extruded plastic and coated tubings, and identification markers.

As a result of the merger, the new officers are as follows: **William Brand**, former president, is now chairman of the board; **Alfred W. Brand,** former vice president, became president; **Frank S. Lombardo,** North Windham plant manager, promoted to vice president in charge of manufacturing; **Abraham G. Ginsberg,** former vice president of Electrical Insulation Corp., named vice president in charge of the Fall River plant operation; **Henry K. Lathrop,** former office manager, promoted to treasurer; and **Betty Brand** named secretary.

Norwalk Plastics Co., Norwalk, Conn., has been formed to take over the plant and physical assets of **Lincoln Plastics Corp.**'s Norwalk operation. **R. G. Brown,** vice president and a director of Lincoln, is president.

Norwalk Plastics will concentrate its operations on injection molding of thin-wall, transparent containers and similar precision molded products. Lincoln Plastics will continue its custom molding operation at its Circleville, Ohio, facility. Mr. Brown remains an officer and director of Lincoln.

Plastic Horizons, Paterson, N. J., plans to move to new and expanded quarters on W. 119 Century Rd., Paramus, N. J., where plant construction now under way is expected to be completed by the end of the year. **Howard C. Bredlau,** formerly with Irvington Varnish & Insulator Div., Minnesota Mining & Mfg. Co., has joined the company in a sales and technical capacity. Mr. Bredlau has been active in the field of polyethylene extrusions for the past seven years.

Union Carbide—Bakelite Co.: Dr. Ivey Allen, Jr., with the company for 27 years, named research coordinator, will be primarily concerned with coordinating the efforts of the Research Dept. with those of Production in the establishment of new products. **Dr. J. S. Whitaker** named manager of patents and licenses. **Donald E. Bisgrove** to Clifton, N.J., sales district as technical representative for the Calendering Materials Div. **Frederick A. Riehl** named technical representative in the Boston, Mass., district for the Calendering Materials Div. **Richard Rieger** appointed technical representative in the Cincinnati, Ohio, district for the Extrusion Materials Div.

Farrel-Birmingham Co., Inc.: Edward S. Coe, Jr., vice president and director, appointed general manager of the company's Consolidated Machine Tool Div., Rochester, N.Y., succeeding **Lester D. Chirgwin. Richard D. Mace,** formerly with the Sales Div., named manager of foundries; he is succeeded in his former post by **G. Wells Eighmy, Jr.**

Monsanto Chemical Co.: John J. Healy, Jr. named director of general development of the Research and Engineering Div., succeeding **Dr. Hal G. Johnson,** who will receive a six months' leave of absence at the end of the year to undertake a government assignment in Washington, D. C. **C. Howard Adams** appointed manager of plastic product development for the General Development Dept. of the Research and Engineering Div.

Plasteel Products Corp., Washington, Pa., has acquired the controlling interest in **Clad Rex Steel Co.,** Denver, Colo. The Denver firm uses a patented process for bonding vinyl sheeting to metal. The resultant product is fabricated into wall panels, ducts, appliances, automotive parts, television and radio cabinets, furniture, luggage, toy novelties, and other products.

Plasteel is a producer of protected metal products. In the Plasteel process, protective asphaltic plastics and mica are applied to specially prepared steel sheets, which are subsequently fabricated into corrugated sheets for roofing and siding installations. **Plasteel Products Co.,** an associated firm also in Washington, produces translucent fibrous glass-reinforced plastic panels for industrial skylighting, side lighting, and a number of farm, home, and commercial uses.

H. B. Wright and **J. M. O'Connor,** founders of Clad Rex Steel Co., will continue to participate in its operations.

Yardley Plastics Co. has purchased the **Decorative Plastic Molding and Plastic Finishing Div. of D. L. Auld Co.,** Columbus, Ohio. The combined facilities will provide Yardley with seven times the manufacturing capacity of the former Auld operation for injection molding in weights from 4 to 60 ounces. **James H. Hosmer,** vice president in charge of the Auld Plastic Div., will be in charge of Yardley's Custom Injection Molding Dept.

Landers Corp.: William L. Haas named to Automotive Sales Div.; **R. Duane Hall** to the Distributor and Jobber Sales Div. The firm manufactures vinyl-coated and processed fabrics for the automotive, furniture, and heavy-duty equipment fields.

The Decro-Wall Corp., 901 Nepperhan Ave., Yonkers, N. Y., has been formed to engage in the sale, distribution, and promotion of three-dimensional Decro-Wall, a vacuum formed vinyl wall covering which simulates brick and stone.

Molded Fiber Glass Body Co., Ashtabula, Ohio, has acquired as a wholly owned subsidiary **York**

(To page 288)

Companies . . . People

& Foster, Inc., Union City, Pa. for use by its Boat Div. York owns total factory space of about 200,000 sq. ft., of which 80,000 sq. ft. has now been put into boat production.

American Cyanamid Co.: In a move to improve delivery, coverage, and service to the do-it-yourself and small package buyer of Laminac polyester resins, the Plastics and Resins Div. has appointed resale agents in eight regions of the country who will specialize in the resale of the company's standard Laminac resins.

Riverdale Color Co., Inc. has moved from 425 South St., Newark, N. J., to larger quarters at 5 Oliver St., Newark. Intensified research in developing a line of new spectrum colors for polyethylene and polystryene and new compounding methods led to a need for increased working quarters.

Bigelow-Sanford Carpet Co., Inc.—Fiber Glass Div.: Sales offices moved from 140 Madison Ave., New York, N. Y., to Amsterdam, N. Y. **James W. Kearns, Jr.** will continue as sales manager of the division at the new location. An eastern regional sales office, headed by **Herbert Davidson**, regional salesman, will be retained at the New York City office.

Republic Industries, Inc., 7350 W. Wilson Ave., Chicago, Ill., has acquired **L. Wikkerink Co.**, Milwaukee, Wis., molder of plastic products. Wikkerink has been supplying molded vinyl electric carpets to the Dor-O-Matic Div. of Republic Industries for use with the Dor-O-Matic invisible Dor-Man automatic door operator for store, restaurant, and institutional type doors.

Wikkerink Co. will continue its operations in Milwaukee as the **Molded Products Div. of Republic Industries** under the direction of **Lance Wikkerink**, former owner, who also becomes chief engineer of New Product Development for both Molded Product and Dor-O-Matic Divs. of Republic.

Tybond Products Co., custom molder, has added 11,000 sq. ft. of floor space to its present facility at 2435 N. Western Ave., Chicago, Ill. **Joseph W. Ohzourk**, formerly plant manager of Chicago Die Mold Co., named technical sales manager.

Wabash Rubber & Plastics Corp. has opened a new 15,000-sq. ft. plant in Seymour, Ind., for the manufacture of plastic items for the appliance and automotive industries.

B. F. Goodrich Chemical Co., formerly at 324 Rose Bldg., Cleveland, Ohio, has established new headquarter offices at 3135 Euclid Ave., Cleveland.

The Pro-phy-lac-tic Brush Co.: C. Edgar Maynard, with the company since 1943, named to head the newly formed Research and Development Dept. **Charles L. Blanchard** will continue his present duties as director of research reporting to Mr. Maynard. **Lewis H. Gustafson** will become director of product development.

Consoweld Corp.: Harry M. Brazener now assistant manager, **William F. Barrett** production superintendent.

E. B. Burnley named sales manager for **National Vulcanized Fibre Co.'s Kennett line** of materials handling receptacles, succeeding the late Robert A. Craig. Mr. Burnley will continue as staff assistant to **Roy S. Fisher**, general sales manager.

Elmer E. Mills has opened an office at 135 S. La Salle St., Chicago, Ill., where he will serve as a consultant on all phases of the plastics industry. Mr. Mills, who opened his own plant in 1937, was a pioneer molder in the Chicago area. Later, he developed a method of producing polyethylene containers. In 1953, upon purchase of his plant by **Continental Can Co.**, Mr. Mills was retained by the company in an advisory capacity, a position which he held until July 31, 1956.

Ernest J. Hill promoted to sales manager of **Colton Chemical Co., a Div. of Air Reduction Co., Inc.**, and will be in charge of sales representatives and agents for Vinol polyvinyl alcohol, Flexbond 800 copolymer polyvinyl acetate, and Colfoam microballoon spheres.

Donn Snyder now with Carbon Black and Pigment Div. of **Columbian Carbon Co.**, with offices in the Park Square Bldg., Boston, Mass., serving carbon black and pigment users in New England.

H. W. Du Val, formerly with The Dow Chemical Co., appointed eastern sales manager of the Chemical Div. of **Reichhold Chemicals, Inc.**

Arthur B. Robinson, named sales manager of **Plastic Products Corp.**, will direct the sales of the firm's Bo-Kay line of molded reinforced plastics flower boxes, planters, bird baths, jardinieres, and related accessories.

George F. Esslinger, assistant district manager of the Philadelphia office of **Armstrong Cork Co.'s Glass and Closure Div.**, will become manager the first of the year, replacing **Bruce A. Ludgate, Jr.**, who will retire.

James May appointed design consultant for Panelyte, a decorative laminate produced by the **Panelyte Div. of St. Regis Paper Co.**

Dr. Herman Schneiderman named technical director of **American Latex Products Corp.**, Hawthorne, Calif., producer of polyurethane foams, rigid and flexible, and foam rubber.

Sidney J. Baum, former general manager of The Borden Co.'s Polyco Dept., appointed general

Companies . . . People

manager of the **Petrochemical Div., Foster Grant Co.,** plastics molder and producer of styrene monomer and polystyrene.

Robert C. Davenport, former vice president of the Sheet Forming Div., Plastic Products Co., joined **Lamex Corp.** as sales manager of thermoplastic sheets.

William C. Wiley named head of a new market development program for the Polyco-Monomer Dept. of **The Borden Co.'s Chemical Div.** He will coordinate marketing activities for the department's entire line of products.

Clyde W. Foster joined the Parts Div. of **Sylvania Electric Products, Inc.** as field representative at the Chicago office. He will handle all of the division's products —molded plastics, bare fine wire, metal stampings, and electronic components.

Robert V. Gilbert, named sales manager of **Molded Fiber Glass Sheet Co.,** will be in charge of sales of fibrous glass-reinforced plastic flat sheet, panels, and other products manufactured by the company.

Walter H. Kuhlen appointed technical sales representative for **Borg-Warner Corp.'s Marbon Chemical Div.** and will cover Pennsylvania, New York, and southern area territory.

Sid Etten, formerly with Duraplast Co. and Rudd Plastic Fabrics Corp., joined **Presto Plastic Products Co., Inc.** as director of sales and development for the leather goods trade and allied industries.

Edwin F. Morfit appointed head of manufacturing of **Sylvan Plastics, Inc.,** a wholly-owned subsidiary of **American Viscose Corp.** Sylvan produces urea formaldehyde molding compounds.

Frank A. Mather, named special representative for the Philadelphia district of the Chemical Div.

Companies ... People

of **The Goodyear Tire & Rubber Co., Inc.,** will work primarily in the sale of Chemigum, Pliolite, and Pliovic latices for textile and paper applications.

Lawrence Charnas appointed research associate in the Photosensitive Vinyl Dept. of **Ferro Chemical Corp.,** a subsidiary of **Ferro Corp.** Mr. Charnas will continue on Ferro's new photosensitive vinyl Calimar. This process reproduces photographs on flexible plastic film.

B. Harding named vice president of **George Woloch Co., Inc.,** New York, N. Y. He was formerly manager of the Akron branch.

Al Fischbein now with the Chicago office sales staff of **Sommers Plastics Products Co.**

John M. Van Loon, Jr. appointed representative in Michigan for **Peerless Molded Plastics,** Toledo, Ohio, custom molder.

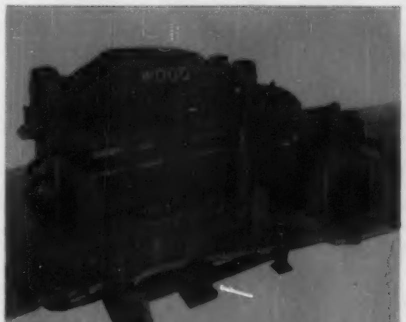
Donald L. McClure appointed general manager of the Corrulux Div., **L.O.F. Glass Fibers Co.,** succeeding **Joseph S. Finger,** resigned.

Frederic S. Dawn now heads up the laboratory staff of **Decar Plastic Corp.,** where he will direct the firm's quality control program of component materials used in the manufacture of Decarlite decorative laminate.

Corrections

The address of Kunstharsfabriek Synthese N. V. appearing in "Benelux: expansion based on research," Modern Plastics 33, 111, August 1956, was incorrectly listed. The correct address is Kortenaerkade 38, Katwijk/Zee, Holland.

Union Chemique Belge S.A., listed as maker of silicones under a Dow Corning license (Modern Plastics 33, 113, Oct. 1956) actually has no license from that firm to manufacture silicones, according to a Dow Corning spokesman.



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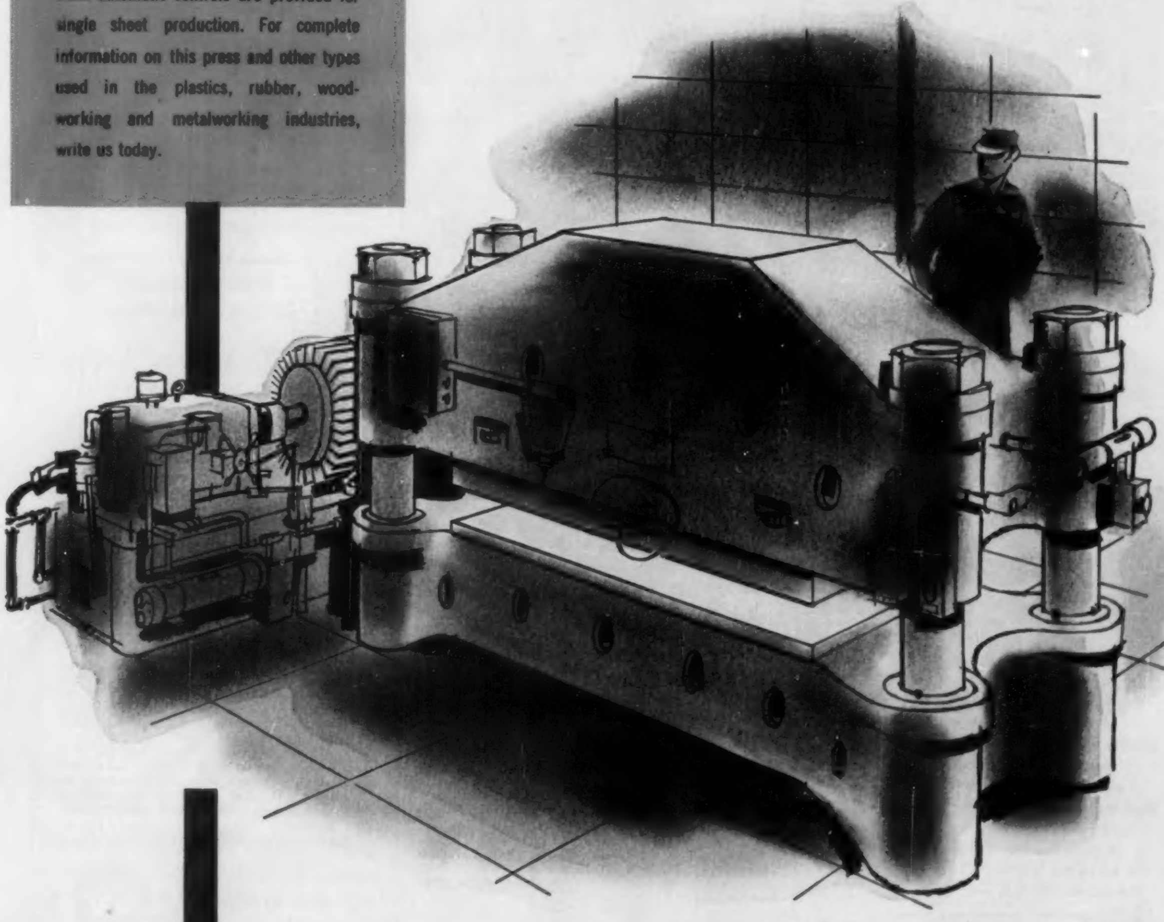

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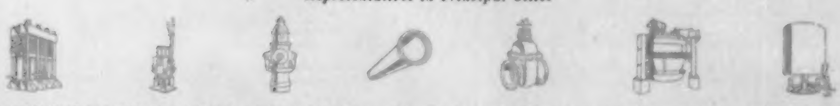

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STATEMENT OF THE OWNERSHIP, MANAGEMENT, AND CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912, AS AMENDED BY THE ACTS OF MARCH 3, 1933, AND JULY 2, 1946, of MODERN PLASTICS, published monthly at Bristol, Connecticut, for October 1, 1956.

State of New York

ss.

County of New York

Before me, Notary Public in and for the State and County aforesaid, personally appeared Charles A. Breskin, who, having been duly sworn according to law, deposes and says that he is the Publisher of MODERN PLASTICS and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the act of August 24, 1912, as amended by the acts of March 3, 1933, and July 2, 1946 (section 537, Postal Laws and Regulations), to wit:

1. The names and addresses of the publisher, editor, managing editor, and business manager are:

Publisher, Charles A. Breskin, 575 Madison Ave., New York City.

Editor, Hiram McCann, 575 Madison Ave., New York City.

Managing editor, A. Paul Peck, 575 Madison Ave., New York City.

Business manager, A. S. Cole, 575 Madison Ave., New York City.

2. The owner is: (if owned by a corporation, its name and address must be stated and also, immediately thereunder the names and addresses of stockholders owning or holding one percent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a partnership or other unincorporated firm, its name and address, as well as those of each individual member, must be given.)

Breskin Publications, Inc., 575 Madison Ave., New York, N. Y.

Charles A. Breskin, 575 Madison Ave., New York, N. Y.

Millie Breskin, 59 Park Road, Scarsdale, N. Y.

Millie Breskin as Trustee, 59 Park Road, Scarsdale, N. Y.

Millie Breskin and Stuart S. Siegel as Trustees, 59 Park Road, Scarsdale, N. Y., 31 Tintern Lane, Scarsdale, N. Y.

S. M. Moisseiff, 860 Fifth Ave., New York N. Y.

E. S. Gregg, 111—Eighth Ave., New York, N. Y.

3. The known bondholders, mortgagees, and other security holders owning or holding one percent or more total amount of bonds, mortgages, or other securities are: None.

4. Paragraphs 2 and 3 include, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting; also the statements in the two paragraphs show the affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner.

CHARLES A. BRESKIN, Publisher

Sworn to and subscribed before me this 8th day of October 1956.

[SEAL] NORMAN B. SMITH, JR.

Notary Public, State of New York No. 41-3740250. Qualified in Queens County. Certificates filed with New York County Clerk.

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SELECTRON Resins are used in products ranging from truck panels that withstand extreme hot and cold, rain, snow, and sleet to television cabinets that serve as focal points of beauty in homes everywhere.

SELECTRON Resins are thermo-setting polyesters which are available in consistency from a thin syrup to extremely high viscosity. They polymerize to form solids, with or without heat and with or without pressure.

When combined with such fillers as fiber glass, cotton, rayon, nylon, felt, sisal, paper, etc., SELECTRON Resins provide a new kind of material that is lighter than aluminum, yet—weight for weight—is stronger than steel. This material has great impact resistance and withstands the deteriorating influence of weather, sunlight, heat, abrasion and many chemicals. It can be molded in durable colors.

Parts in which SELECTRON Resins are used can be molded either by hand lay-up, direct molding, continuous lamination or pre-forming. These resins can also be used without fillers for casting, potting and impregnating.

Investigate the advantages of SELECTRON Resins that may make your products better looking, stronger and more durable. We'll be glad to have one of our engineers discuss your problems with you without cost or obligation. Such a visit may point the way to important production economies and added sales appeal.

SEND FOR FREE BOOKLET

● Write, wire or phone today for our new booklet containing description of SELECTRON Polyester Resins and explaining many of the ways in which they can be used. Pittsburgh Plate Glass Company, SELECTRON Products Division, Gateway Center, Pittsburgh, Pa.

Just a few products in which Pittsburgh SELECTRON Resins are now used—

Aircraft structural parts
Radomes for electronic equipment
Life floats
Ballistic panels
Helmets
Boat hulls
Machinery housing and guards
Trays
Tote boxes
Food lockers
Garbage pails
Baskets for automatic dishwashers
Baskets for automatic washers
Wash tubs
Tool chests
Shipping containers
Instrument cases
Laundry hampers
Kitchen containers
Fishing rods
Sinks
Street signs
Traffic signs
Fluorescent light fixtures
Television cabinets
Loudspeaker housings
Gas meter housings
Structural panels for offices and homes
Door and transom lights
Awnings and canopies
Greenhouse panels
Skylighting
Molded chairs
Prefabricated houses and garages
Truck bodies

PITTSBURGH Selectron

PAINTS • GLASS • CHEMICALS • BRUSHES • PLASTICS • FIBER GLASS

PITTSBURGH PLATE GLASS COMPANY

IN CANADA: CANADIAN PITTSBURGH INDUSTRIES LIMITED

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Employment

Business opportunities

Equipment

Used or resale only

Machinery and equipment for sale

FOR SALE: 1—Stokes standard 150 ton molding press; 1—Watson Stillman 50 ton electrically heated press; 1—Royle 4½" electric extruder; 1—Mitts & Merrill model 10-N-6 pelletizer; 7—Cumberland #½ granulators, 3 HP; also mills, extruders, etc. Chemical & Process Machinery Corp., 52 Ninth St., Brooklyn 15, N. Y.

FOR SALE:
Lester type L-2-8 Injection Molding Machine, 8 oz. capacity, complete with instruments. Excellent running condition, immediate delivery. Can be seen in operation.
Sterling Plastics Co.
1140 Commerce Avenue
Union, New Jersey

FOR SALE: Thermatron Electronic generators—less than 1 yr. old. 1—10kw w/ 24x55 press Cost $7000 Sell $4800. 2—4kw w/ 18x30 oversize presses Cost $3825 each—Sell $2500 each. All perfect, can be seen operating until Oct. 31. Will include 5HP compressor on complete purchase. Service & Installation arranged. FOB NYC Algonquin 5-3956.

FOR SALE: Lester injection Machines, others. 150 ton Hobbing Press, 50 ton 12"x12" Presses, 100—400 ton, 36"x36" platen Molding Presses. New ¾" 3000 psi Double Solenoid, 4 way Valves. New ¾" 3000 psi Cam operated Valves. Carver Laboratory Presses, factory reconditioned. New 6"x12" Laboratory Mills. Plastic Machinery Exchange, 426 Essex Avenue, Boonton, N. J., telephone DE 4-1615. Cable address "Plasmex Boonton."

FOR SALE: 20 oz. Lester-Phoenix Injection Molding Machine. New 1953. Excellent condition. May be seen in operation; location Michigan. Reply Box 1523, Modern Plastics.

FOR SALE: Cutters, Rotary, Plastic: Ball & Jewell Midget 1 HP MD, Van Dorn Model G-100, 1 HP MD, Abbe Size "0" 5 HP MD 9"x17" Hopper Mouth, Ball & Jewell #1 10 HP MD. Die Casting Machines: Loch Engineering, Zinc, Motor Drive 10 HP. Extruders: Laboratory 2" Screw 1 HP MD Elec. Heated, Royle No. 1, 2" Screw 15 HP MD, Royle No. 1, 3 stage Oil Heated, Excellent Condition, No. 2 Royle 15 HP Motor, 3¼" Screw, Elec. Htd. Die Head, No. 3 Royle 30 HP Motor Drive, 4½" Screw, Side Delivery Q. O. Head, Allen-Williams, 8" Strainer Head, 40 HP Motor Drive, 4 Zone, Elec. Htd., 4" Screw, 60" Barrel, Practically New, 4½" NRM 104" Barrel 40 HP Vari-Drive Used 1 Month. Injection Molding Machines: 1 oz. Van Dorn Model H-200, 2 oz. HPM No. 54 Clamp 22 Ton, Injection 12 Ton, Manual Controls, 2 oz. NRK No. 1300 Plasticor Vertical, Hand Operated, 2 oz. Van Dorn Model H-200 1953 Never Used, 2 oz. Watson-Stillman, Frame 6 oz. Cap., Motor Drive 20 HP, 1945, 2 oz. Watson-Stillman Vertical Motor Drive, 3 oz. Fellows Fully Automatic, 4 oz. DeMattia Semi-Automatic, 4 oz. Crown Moldmaster Complete Fully Automatic, 4 oz. Reed-Prentice Wheelco Controls 15 HP MD, 6 oz. Watson-Stillman, 8 oz. Reed Prentice Double toggle, 8 oz. Impco Mdl. VF-8, Compress. & Transf. Features, Extra 12 oz. Cyl., 9 oz. HPM 200 Ton Fully Automatic, 12 oz. Lester W/Glengarry Weigh Feed, 16 oz. Reed-Prentice No. 10-E-16, Electric Heated, 1948, 22 oz. Impco, Model VF 8-22, 24 oz. DeMattia Model B, Inspect in Operation. Mills, Rubber, Plastic: 6"x13" Farrel Laboratory 7½ HP MD, 16"x40" Farrel, Rubber/Plastic, 16"x48" Farrel, Rubber/Plastic, 18"x50" Thropp Motor & Drive all on one Bed Plate, 18"x50" Farrel, Rubber/Plastic, 4 in Line or Individually, No. 2 Abbe Eng. Co., Eureka Porcelain Jar Mill, Roller Chain, Motor Drive (2). Presses, Hydraulic: 2 Ton Denison 3 HP MD, (4 Ton Denison, 3 HP, MD) 5 Ton Logan, Twin Ram 7½ HP, MD, 10 Ton Denison 7½ HP MD, 15 Ton, Stokes No. 200D-2 Automatic (10), 15 Ton Consolidated Self Contained, 20 Ton, Elmes No. 3429P Laboratory, Electrically Heated Platens 8"x8", 25 Ton Consolidated 24"x30" Self Contained Pump & Motor, 30 Ton, Watson-Stillman Laboratory, Platens 8"x8" (2), 30 Ton Watson-Stillman 4½" Ram x 18" Stroke 12½ LR-16" F-B 22" DLO MD, 30 Ton, Baker, Full Automatic Model 958, Excellent Condition, New 1951, 30 Ton, HPM Upmoving 12"x12" Platen 12" DLO 12" Str with Controls. 35 Ton, HPM Down-Acting, Ram 6"x6" Str., Bed 12"x6", DLO 15", Self-Cont., 40 Ton, Francis 4 Opening, 12"x12" Elec. Heated Platens, 40 Ton, Loomis, 4 Opening, 12"x12" Elec. Heated Platens, MD Self-Cont., 50 Ton Baldwin-Southwark Angle Molding Press, Practically New, 50 Ton Bliss 20"x20" Platen 20" Str. 60 HP MD, 50 Ton, Stokes, Semi-Auto., Slf. Cont. 50 Ton Farrel 12"x12" Upmoving, 50 Ton, Watson-Stillman, 12"x17" Elec. Htd. Platens, MD Pump, 75 Ton, Farquhar, Up-Acting, 30"x42" Platens, 100 Ton, Farquhar, Drawing, Stroke 30", Hi-Speed Appr., Press, Return, 100 Ton, Farquhar, Self-Cont., Down Acting Ram 11"x26" Str. 30"x28", 100 Ton, Watson-Stillman, Platens 13"x13", Ram 8½"x3" Str., MD Pump, 100 Ton, Watson-Stillman, 4-Post, Platens 11¾"x12", Ram 8"x15" Stroke, 100 Ton, Watson-Stillman, Bed 22"x20", DLO 24", Self Cont., 113 Ton Stewart Bolling 20"x20" Steam Platens 12" Upmoving Ram x 14" STR, 100 Ton Lake Erie Hi-Speed, 24x24" Bed, 12" DLO, Self-Cont., 150 Ton, Carey, Platens 20"x16" Adj., DLO 8"-28", 200 Ton Elmes 14" Ram x 42" Str. 24"x30" Bed, 225 Ton Farrel 14" Ram x 18" Stroke L-R 26½" x F-B 24½" 7½ HP MD, 250 Ton Niles-Bement-Pond Wheel Press, 275 Ton Watson-Stillman Upacting 24"x54" Platens 2-14" Rams, 300 Ton Watson-Stillman Transfer Press 33"x27" Platen, Auto., 300 Ton, Lake Erie, 30"x30" Platens, Self. Cont., Semi-Auto., 350 Ton, Elmes, Self-Cont., Down Actg., Ram 19"x20" Str., 30"x36", 393 Ton Farrel, 2 Openings 15" x Steam Platens 48"x48", 4 Rams 10"x24" Str., 600 Ton, Watson-Stillman, Hobbing, Motor Driven Pump. 625 Ton, Farrel, Steam Platens 52x52" Pump, Mtr., Controls, Under Power. 669 Ton, Morane, 3 Upmoving Rams, 16" Stroke, 750 Ton, HPM, Down Act., Bed 59"x44", DLO 72" Ram 28"x43" Str., 1200 Ton, HPM, 15 Openings, 100"x120" Steam Platens, Self-Cont. (2), 2400 Ton, Birmingham, Belt Press, 65"x26'6", 24-11" Rams. Pulverizer: Model #W30-H-SP Buffalo, With Dexter Sheet Feeder. Presses, Plastic Molding: 15 Ton, Stokes No. 200D-2 Automatic (10), 30 Ton, Baker, Full Automatic Model 958, Excellent Condition, New 1951, 50 Ton, Stokes, Semi-Auto., Slf. Cont., 50 Ton, Watson-Stillman, 12"x17" Elec. Htd. Platens, MD Pump, 215 Ton, Lake Erie, Semi-Automatic, Self-Cont., Hydr. Plastic Molding. Presses, Transfer: 300 Ton, Watson-Stillman Hydraulic Transfer Press, 33"x27" Platen Auto. Furnaces and Ovens: Megatherm, 3/60/220, 3 KW, 2-3 lb. Phenolic per min. (8), Despatch Mdl. Diaz-7583, 3 Drawers, 17"x17"x5" (2), Despatch Mdl. Plhd-8, 8 Drawers, 12x18x2½" (2), Thermex, Mdl. x 875, 1 Ph., 60 Cy., 230 U, Thermonic Induction Heater Model M-285 12 KVA At Full Load, Lydon, 21 Drawer, Pre-heating Ovens, Motor & Blower ¼ HP Motor 6'x18"x30", Gehnrich Gas-Fired 6'x6'x6' Walk-In Heat to 400°. Tablet Machines: Model 280-C 100 Ton Single Punch. Model G-4 Stokes Single Punch Dual Pressure 15 Ton MD, Model T Stokes, Hydraulic Equalizer, Motor Drive, 3 HP, Model R Stokes, Single Punch, Variable Speed Motor Drive, 3 HP, Model R-1 Stokes, Sgl. Punch, Vari-Speed, MD, 3 HP, No. RB-2 Stokes, 16 Station, Motor Drive, 2 HP, Model S-5 Stokes Dual Pressure, 40 Ton, Motor Drive 72 HP, 1952, Model RDS3 Stokes, 15 Station, Motor Drive 3 HP, Model 45 Defiance, 200 Ton, 15 HP, Vari-Speed, MD, No. 2 RP Colton, 16 Punch, Rotary, Motor Drive 1½ HP, No. 3RP Colton, 16 Punch, Rotary, Motor Drive 1½ HP, No. 280G Stokes, Single Punch, Model F, Stokes, Single Punch, MD, No. 5 Arthur Colton, Motor Drive, 3 HP, No. DD-2 Stokes, 19 Stations, US Vari-Drive, 10 HP, No. DDS-2 Stokes, 23 Stations, US Vari-Drive, 10 HP, No. DD-2 Stokes, 23 Stations, Reeves Vari-Speed Drive 7½ HP, Model E Stokes Single Punch 2 Ton Vari-Speed MD, Model 5½ Arthur Colton Motor Drive 3 HP. Pumps: 200 GPM, 2500 Psi Worthington Horizontal, Duplex, DA 3¾"x18". Mixers: 100 Gal W & P Jacketed Sigma Blades Air Cylinder Tilt, No. 3A Banbury, 150 HP MD Rubber/Plastic, No. 3 Banbury 150 HP MD Excellent, No. 9 Banbury, Body Only, No. 9 Banbury 200 HP Motor Drive, Inspect in Operation Rubber/Plastic, 5 Gal. Paterson-Kelly Stainless Steel with Agitator ¾ HP MD Elec. Htd., No. 11 Banbury, Bodies Only (2). Calenders: 6"x13" Farrel Laboratory, Like New, 9"x48" American Tool, 2 Roll Doubling, Belt Drive, Rubber, Plastic, 24"x48" Farrel-Birmingham, 3 Roll, 50 HP DC Motor, 14" Web John Waldron 2 Roll Embossing Calender 3 HP Vari-Speed, Never Used. Take-Up Equipment: 30" Watson, Type D-C, Take-Up, 30" Royle, Cable Take Up, 36" Royle, Capstan, Take-Up. Trimmer: 50 Ton Model Metal Stamping Trimmer Model 1C-¼-6 Fully Automatic. Impregnators: No. 56 Av. Stokes Vacuum with Storage Tank 29¼" Dia x 42" Vac. Pump. Johnson Machinery Co., 679-P Frelinghuysen Ave., Newark 5, N. J., What do you need? What do you have to sell?

(Continued on page 298)

(Continued from page 296)

FOR SALE: Vacuum Metallizer, Stokes 36". Injection Presses: 8, 24 oz. Reed, 4, 9, 16 oz. HPM, 12 oz. Watson, 8, 12 oz. Lester, 8 oz. vertical Gidding & Lewis, 4 oz. Lewis, 1 oz. Van Dorn. Extruder: 2" steam htd. NRM Saran Pipe setup. Conveyors, Scrapgrinders, Ovens. Compression & Transfer Presses: 50 to 600 tons. 30 T. Elmes Hydrolair, 15 T. Stokes Automatic. 2 KW Cutler-Hammer electronic Preheater. Auto-Vac 52x30" Vac Forming Machine. Comet 36"x48" double table Drape Form. Machine. Autom. SprayMask Washer. Day-Mixer size 0. All Midwest Locations. List your Surplus Equipment with me. Justin Zenner, 823 Waveland Ave., Chicago 13, Ill.

FOR SALE: With one year full service guarantee, all surplus hydraulic machinery, plastic working equipment, engineered and re-built to most exacting production requirements, including Stokes, Baldwin and H.P.M molding presses up to 300 tons. Two 300 ton laminating presses 48x42. Four 170 ton 17x16 platen, fully guided, any required d.l. Listings on manufacturers surplus equipment for disposal include, in good condition; 8-12-16 and 20 oz. injection molding presses, Defiance 75 ton preform press. 200 ton F.O.M. transfer press. Hartig 4½ extruder. New custom-built to operating requirements for any hydraulic press, Dua-matic power units with complete hydraulic system for automatic timed or manual cycling, volume up to 100 GPM, pressure to 6000 PSI. Any plastic working machine procured on commission or service charge basis, including our thorough inspection and survey. Give us your plastic machinery requirements for competent engineering sales service covering the plastics industry only. We solicit manufacturers surplus listings and those of dealers in machine tools, disposing of hydraulic machinery and plastics processing equipment. J. F. O'Connor & Son, Hydraulics Industrial Service, 2020 Renfrew Ave., Elmont, New York.

FOR SALE: Marco Process consisting of: Homogenizer, Roto-Feed Mixers, Reactors, Kom-Bi-Nators and pumps, all stainless steel. Heavy Duty Double Arm Sigma Blade Mixers. (2) Readco 50 gal. 30 HP; (2) W & P 50 gal. and 100 gal; (2) J. H. Day 75 gal. stainless steel. (2) Kux Rotary Pellet Presses. (4) Horizontal Ribbon Mixers 336 cu. ft. (12,000#); 105 cu. ft. (4000#) capacity. Stainless Steel Reactors or Autoclaves: 1420 gal., 465 gal., ½ gal. (1) St. St. Pug Mill 7" diameter x 3'9" long overlapping chambers, jacketed 75#. (4) Mikro Pulverizers #2DH, #2TH, #3TH. (3) Fitzpatrick Stainless Steel Comminuting Machines, Models D, K & F. We buy Your Surplus Equipment. Perry Equipment Corp., 1429 N. 6th St., Phila. 22, Pa.

EXCEPTIONAL EQUIPMENT—RESALE. Just purchased: Hydraulic Presses; 600 Ton, 300 Ton, 125 Ton and 35 Ton all with Heated Platens; Heavy Duty Baker Perkins Double Arm Jacketed Mixers 300 Gal., 200 Gal. and 100 Gal.; Brand New Falcon Double Ribbon Mixers in Stainless or Steel, all sizes in stock; Devine No. 23 Vacuum Chamber Dryer; Dbl. Door; 13 shelves 59"x78" complete with all accessories; Stokes Preform and Pelleting Presses; Extruders, Strainers, Tubers, Injection and other Molding Presses; Rubber Mills, Calenders, Vulcanizers, Bale Cutters, Rotary Cutters; For fast accurate reply to your inquiry, write to:
First Machinery Corp.
209 Tenth Street
Brooklyn 15, N.Y.

FOR SALE: One (1) Model 40-A Mini-Jector, manually operated, ¾ Ounce Capacity, Mold included. Used approximately 3 hours. $75.00 off selling price. Bill of Lading attached, 25% down with order. Reply Box 1530, Modern Plastics.

FOR SALE: Hartig 3¼" Plastic Extruder. VanDorn 1 oz. Injection Molding Machine. Stokes R. 2½", single punch, Perform Machine, Kux 2⅛" dia., single punch Preform Machine. Farrel 15"x36", 2-roll mill. Mills and Calenders up to 84". New Seco 6"x13" and 8"x16" Lab. Mixing Mills and Calenders. Plastic and Rubber Extruders. Oxford 57" Slitter. HPM 1200-ton Laminating Press, 15 openings, 100"x120". Brunswick 225 ton 21"x21" platens. Farrel 200 Ton 30"x30" platens. 200 ton Hobbing Press 18"x14" platens. D&B 140 ton, 36"x36" platens. W-S 150 ton Semi-automatic, 24"x24" platens. D&B 150 tons 24"x24" platens. Adamson 80 ton, 20"x20" platens. Farrel 200-ton 20"x80" platens. Southwark 30 ton 14"x14" platens, semi-autom. Also Lab. to 2000 tons from 12"x12" to 48"x48". Hydr. Pumps and Accumulators. Stokes Automatic Molding Presses. Rotary and single punch Preform Machines, ½" to 4". Injection Molding Machines 1 oz. to 60 oz. Baker-Perkins & J. H. Day Jacketed Mixers. Plastic Grinders. Gas Boilers. Partial Listing. We buy your surplus machinery. Stein Equipment Co., 107-8th Street, Brooklyn 15, New York. Sterling 8-1944.

FOR SALE: Stainless Steel Rotary Dryer. Link Belt Co., 5'2"x16". No. 502-16, with all aux. equip. Roto louvre also 6'x24' and 5'x26'. Hersey Stainless Steel Rotary Driers. Reply Box 1518, Modern Plastics.

FOR SALE: 1—Royle #4 Extruder, motor driven; 1—6"x12" Laboratory Mill, m.d.; 1—Ball & Jewell Rotary Cutter, size O m.d.; 2—Baker-Perkins Size 15, 100 gal. Jacketed Mixers: 5—Horizontal Dry Powder ribbon Mixers, 4000#, 1500#, 500#; 1—New 3 Roll 6"x16" Laboratory Calender; 1—Farrel-Birmingham 60" Mill with reduction drive, 150 HP motor, floor level mounting; 1—Fitzpatrick "D" Comminutor, S.S. contact parts, jacketed; 1—Mikro Pulverizer #2th, with motor; 4—Reed-Prentice & W-S Injection Molding Machines , 2-16 oz.; Also other sizes: Hydraulic Presses, Tubers, Banbury Mixers, Mills, Vulcanizers, Calenders, Pellet Presses, Cutters. Send us your inquiries. What have you for sale? Consolidated Products Co., Inc., 50 Bloomfield Street, Hoboken, N. J. HOboken 3-4425, N.Y. Tel.: BArclay 7-0600.

NEW ARRIVALS FOR SALE: French Oil Mill Mchy. Compression Molding Presses; 75-170 tons, 3-170 tons, 35"x18", 5-95 tons 29"x18", 3-75 tons 18"x17", 5 Preheaters 2 KW, Wood 20"x20" 12" ram 170 tons; Southwark 24"x24" 12" ram. 170 tons; Baldwin Southwark 4-26"x26" 8" rams, 75 tons; 5-26"x26" 7" rams 57.7 tons; 2-15"x15" 8" rams 75 tons; 2-19"x24" 10" rams, 78 tons; 2-12"x12" 7½" rams 66 tons; 2-D&B 12"x12" 7" rams, 57.7 tons; 8"x9" 4½" rams, 24 tons; D&B 12"x12" 3" rams, 10 tons; HPM Transfer Molding 75 tons; Preform Presses, Colton 5½T Stokes R and DDS-2MD; New Universal Dual Pumping Units 3-15 HP; Lab. Mills and Calenders; also Extruders, Mixers, Vulcanizers, Injection Molding Units, etc. Universal Hydraulic Machinery Co., Inc., 285 Hudson St., New York 13.

FOR SALE: 3—Ball & Jewell #2, #1½ Rotary Cutters; 1—Cumberland #0 Rotary Cutter; 4—Two Roll Mills 20"x22"x60". 15"x40", 6"x14"; 3—Baker Perkins 100 gal., 50 gal., 2 gal., jacketed double arm Mixers; 1—Stokes Rotary Preform Press #DDS2; 3—Stokes Model "R" single punch Preform Presses; 1—Kux Model 15-25 Rotary Press; Also: Sifters, Banbury Mixers, Powder Mixers, etc., partial listing; write for details; we purchase your surplus equipment; Brill Equipment Co., 2407 Third Ave., New York 51, N. Y.

FOR SALE: (11) 75 ton record presses, complete @ $2,450, (11) new 100 ton, 10" ram, 10" stroke @ $1,100, (8) 200 ton, 9" stroke, 14" ram, 36x36 @ $1,850, (7) 200 ton, 9" stroke, 15" ram, 30x30 @ $1,650. (1) 50 ton complete. 18x18 @ $1,850. (1) 200 ton, 16" ram, 30x30 @ $2,450. (2) 200 ton, 16" ram, 42x42 @ $2,850, (1) 200 ton 15" ram, 42x42 @ $2,450, (4) 250 ton, (2) 12" rams, 30x60 rebuilt @ $3,375. Hydraulic Sal-Press Co., Inc., 388 Warren Street, B'klyn, N. Y.

FOR SALE: (2) 300 Ton W.S. Presses 20x 20 & 29x24 Platens. 140 Ton W.S. 22x16 Platen. 85 Ton Waterbury Farrel 20x24 Platen. 63 Ton Press 15x15 Platen with Pullback Cyls. 9, 8, 4, Oz. Injection Molding Machines. 15 Ton Lab. Presses 10x8 Platen. 10 Ton Lab. Presses 6x6 Platen. Standard Mystic Embossing Presses, Accumulators, Pumps, Valves. 250 Ton W&S 28x24 Patens, 80 Ton Farrel 24x24 Platens. Many other Presses—Send for Bulletin. Aaron Machinery Co., Inc., 45 Crosby St., New York 12, N. Y. Tel.: WAlker 5-8300.

FOR SALE: 60 oz. H.P.M. w/1200 ton clamp; 48 oz. H.P.M, 1955; 48 oz. DeMattia; 32 oz. Lester, 1950, $22,000; 16 oz. Mod. E. Reed-Prentice, 1948, $13,000; 16 Impco vert w/10 oz. cyl., $7,500; 16 oz. H.P.M., 1946, $11,500; 12/16 oz. DeMattia, fully hyd., 1951, $10,000; 12 oz. DeMattia, $7,500, terms; 12 oz. Lesters; 8 oz. Reed-Prentice, 1946, $7,000; 9 oz. H.P.M. w/12 oz. cyl, 1945, $7,500; 8 oz. Lester, 1946, $5,500; 8 oz. Leominster, 1946, $3,500; 6 oz. Reed-Prentice 1946, $6,500; 4/6 oz. Reed-Prentice, 1955, w/low pressure closing, fully aut., $10,500; 4 oz. Lester, 1953, fully aut., $8,500; 4 oz. Watson-Stillman vert. 1949, $5,000; 4 oz. H.P.M. 1948, $4,500; 4 oz DeMattia vert. new; 3 oz. Fellows, 1951; 2 oz. Reed-Prentice, $1,500; 2 oz. Isoma, fully auto., $1,500; 2¾ oz. Clifton, new, $3,350; 2½ oz. Moslo Mini-jector, used cylinders, grinders; Model F Packaging machine; Auto. spraying machine; Stokes presses; all types new and used plastic machinery—Let us list your surplus equipment. Acme Machinery & Mfg. Co., 102 Grove St., Worcester, Mass.

FOR .SALE: Injection Machines. Two "Impco" HA-65—2 to 3 oz. Fully automatic. Stroke adjustable to 15 inches. One of the machines we are offering is the machine that was at the 1954 Cleveland Plastics Exposition. F. J. Kirk Molding Co., Inc., Clinton, Massachusets.

FOR SALE: 6 ounce Lester, 2B-44-6, 1944 model. 10D-8 ounce Reed-Prentice, 1948. L-2½-8 ounce Lester, 1947 model. 16 ounce Watson-Stillman, 1949 model. Model 1-4-4 ounce Lester. Reply Box 1505, Modern Plastics.

(Continued on page 300)

SELF-SERVICE DE LUXE

with the HEINZ

"ROLL-RACK" BABY FOOD DISPENSER

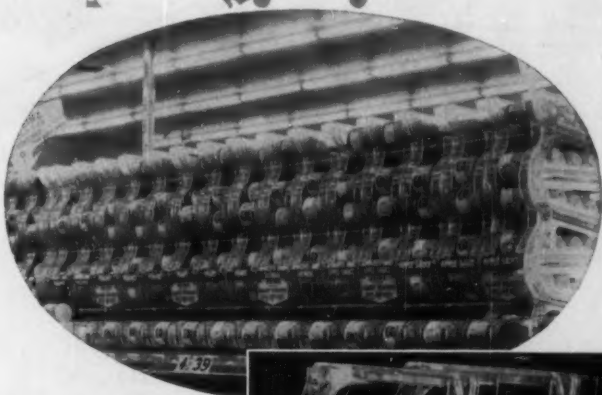
custom-molded by . . . ERIE plastics

The "Roll-Rack" combination display unit and dispenser is a most ingenious device for the purpose. It provides quick, easy self-service to the customer and automatic "first-in first-out" stock movement for the dealer.

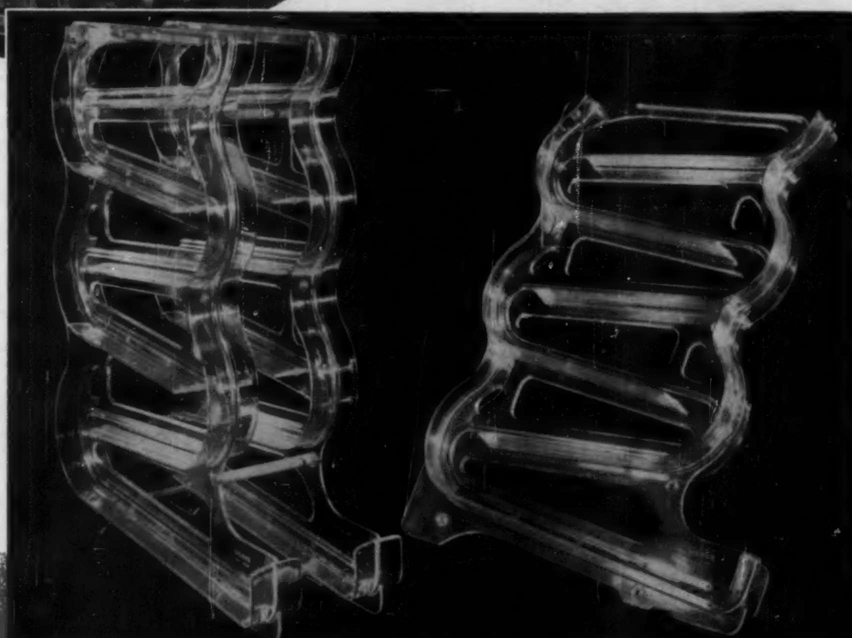
The plastic item is the main panel. The "track" is duplicated on both sides of the panel . . . thus a single panel serves as the reverse sides of adjoining compartments. Any number of panels may be secured together, depending on the space to be used for the display.

This patented dispenser, designed by the Roll Rack Company, Youngstown, Ohio, is molded from crystal general purpose polystyrene in a two cavity mold and 60 ounce molding machine equipped with a pre-plasticizing unit. Economy and ease of molding were factors in the choice of material. Clear plastic was chosen for high visibility through the sides of the units.

The "Roll-Rack" for Baby Food is a Heinz Baby Food exclusive and is another intricate custom molding job by ERIE Plastics. ERIE Sales Engineering Department is available to help you solve your custom molded plastics problems.



Above: Heinz Baby Food display in "Roll-Rack" Dispensers in a large Super Market



Right: Sections of the "Roll-Rack"

ERIE plastics

ERIE PLASTICS DIVISION

ERIE RESISTOR CORPORATION

Main Offices and Factories: **ERIE, PA.**

Manufacturing Subsidiaries

HOLLY SPRINGS, MISSISSIPPI • LONDON, ENGLAND • TRENTON, ONTARIO

(*Continued from page 298*)

VACUUM PUMP 2000 CFM.
Fractional Micron Mfg. Westinghouse, Government Surplus.
Components Beach-Russ, 100 CFM Mechanical pump operated by 5 HP, 440 v, 60 Cycle, 3 P. Motor, Booster Oil Pump, 5000 W Calrod Heater. Oil diffusion Pump, Mechanical Refrigeration unit. 2 Westinghouse McLeod Gauges. 12" Valve at outlet of diffusion pump. Units have been tested as low as 50 Milli-Microns. Condition used, good. Quality 7. Price $2,750.00 each.
MILT GROBAN
9656 So. Merrion Ave.
Chicago 17, Ill. Phone—SA 1-3442

FOR SALE: Hydraulic Platen Presses—upward acting, 2—Nat'l, Erie 2,000 ton, 45-54 Platens. 24" opening. 1—750 ton Nat'l. Erie, 36"x36" Platens, 24" opening. 1—100 ton, 24"x24" Platens, 12" opening. 1—75 ton, 24"x24" Platens, 18" opening. Capac Industries, Inc., Capac, Michigan.

FOR SALE: 16-20 ounce injection press, HPM, complete with new oil-gear system. Has new Superheater, new 3,000# oil gear main pump, new Oil Gear 4,000# holding pump, new wheelco capacilines and electrical panel. 8 ounce Lester press. Both presses $22,500. U. S. Products, Box 114, Flint, Michigan.

AVAILABLE AT BARGAIN PRICES: Baker Perkins 50 gallon capacity Stainless Steel Steam Jacketed Heavy Duty Mixers with Stainless Jacketed Blades, motorized power tilting, motor driven. W & P 200 gallon Heavy Duty Mixer, tilting type, with Sigma Blades. J. H. Day from ¾ up to 100 gal., Imperial and Cincinnatus D.A. Jacketed, Sigma Blade Mixers. Day 15 to 10,000 lbs. Dry Powder Mixers. Mikro Bantam, 1SH, 1F, 2TH, 3TH Pulverizers. Gemco 2000 lbs. 56 cu. ft. Double Cone Blender. Day, Rotex, Tyler-Hum-mer, Robinson, Raymond, Gayco, Great Western Sifters. Colton 2RP and 3RP Rotary Tablet Machines. Carver Laboratory 20 ton hydraulic Press. Package Machy. FA, FA2, FA4, Miller, Hayssen, Scandia, Hudson Sharp, Oliver Auto. Wrappers—all sizes. This is only a partial list. Over 5000 machines in stock available for immediate delivery. Tell us your machinery requirements. Union Standard Equipment Co., 318-322 Lafayette St., N.Y. 12, N. Y.

Machinery and equipment wanted

WANTED: Used Carver Laboratory Press, with or without heating plates. Advise serial number or age, condition, and asking price. Box 1532, Modern Plastics.

WANTED: Used granulator—Cumberland Model 20—40 HP or Alsteele 9x24—40 HP. Reply Box 1526, Modern Plastics.

WANTED: Used 12" or 16" 3-roll calender. Also interested in a used 36" or 48" 3-roll calender. Box 1520, Modern Plastics.

WANTED: 1-oz. Used injection molding machine. May be hand or power operated. Box 1504, Modern Plastics.

Materials for sale

FOR SALE: Lester 12 oz. Fully Automatic Plastic Injection Molding Machine; (2) Lester 6 oz. (Model 2B) Automatic Plastic Injection Molding Machines; (2) Lester (Model HHP2) 5# Die Casting Machines; Stokes Model "F" Preform Press: Stokes Model S4 Tablet Press 40 Ton; Stokes Model P3 Press 80 Ton. We also recently liquidated a Plastic Button Plant and will sell: Plastic Button Molds and Dies; Urea, and Phenolic Molding Powders (all colors); Tumbling & Waxing Barrels; Stokes Granulator; Day Blender; Four Slide Wire Formers for Loops; Button Tack Wire Formers; Button Circle Insert Formers; Button Fastening Machines. All equipment is in very good condition, just as removed from service in the Plant. Write for complete information, we will furnish sample buttons that the Dies made and be happy to fully cooperate with interested parties. Globe Trading Company, 1815 Franklin St., Detroit 7, Michigan. Phone: WOodward 1-8277.

Materials wanted

WANTED.
Plastics Scrap and Rejects of all kinds. Ground and unground. Also rejected molded pieces and surplus virgin molding powders. Top prices paid.
A. Bamberger Corporation
703 Bedford Ave., Brooklyn 6, N. Y.
MAin 5-7450

WANTED: Plexiglass and Lucite scrap, salvage and cut-offs, any quantity. Turn your surplus sheet stock into cash. Ask for our quotation. Duke Plastics Corp., 584 Broadway, B'klyn 6, N. Y. EVergreen 8-5520.

WANTED: Plastic Scrap. Polyethylene, Polystyrene, Acetate, Acrylic, Butyrate, Nylon, Vinyl. George Woloch, Inc., 601 West 26th Street, New York 1, N. Y.

SCRAP WANTED.
Acetate, Butyrate, Polystyrene, Acrylic, any quantity. Also list your surplus inventory of Virgin molding material with us for sale at highest prices.
Claude P. Bamberger, Inc.
1 Mount Vernon St.
Ridgefield Park, N. J.
Tel: HUbbard 9-5330. Not connected with any other firm of similar name.

Molds for sale

FOR SALE: Complete line of Houseware Molds, Comb Molds, also some novelty and specialty items. No reasonable offer refused. Send for list. Reply Box 1534, Modern Plastics.

PLASTIC MOLDS FOR SALE.
Household items, either for domestic or foreign use.
(Reply Box 1519, Modern Plastics.)

Molds wanted

WANTED: Molding Dies for Ball Knobs, Control Knobs, etc. Send full particulars, prices and samples to: Rogan Bros. 8031 N. Monticello Ave., Skokie, Ill.

Help wanted

BREA CHEMICALS, INC.
Subsidiary of Union Oil Company of California Brea is now forming a national Plastic Sales Department. We want aggressive, experienced men for Regional Sales Manager and Technical Service Manager positions. Build your future faster with substantial growth in a young and progressive company. Write us in detail about your experience and references. All inquiries will be treated confidentially and answered promptly. Interviews will be arranged at your convenience.
Write or phone:
Brea Chemicals, Inc.,
714 West Olympic Blvd.,
Los Angeles 15, California

PLASTICS ENGINEER: with sales ability for well-established custom injection molding plant in Los Angeles area. Must have full understanding of injection molding and machines, and be able to design and estimate molds and production costs. Should be qualified to manage plant during owner's absence. Excellent opportunity for versatile man with initiative. Replies held strictly confidential. Write Box 1521, Modern Plastics.

WANTED: Man with chemical background experienced in laminating reinforced plastics. A young and rapidly expanding fabricator in midwest wants man with 8-10 years experience in laminating reinforced plastics. This is a development job not production. Good opportunity, good future, good salary. Applications will be kept confidential. Reply Box 1500, Modern Plastics.

PLANT SUPERINTENDENT.
'Ground floor' opportunity for man experienced in: close tolerance injection molding, hot stamping, finishing operations quality production & machine maintenance. All Company Benefits. Starting $7500-11,000.
Reply Box 1502, Modern Plastics.

MOLDING POWDER SALESMAN: We distribute and deal in a complete line of thermoplastics materials, virgin and reprocessed. Require experienced salesman. Rapid opportunity advancement. Send complete resume stating salary desired. Replies held in strict confidence. Reply Box 1528, Modern Plastics.

PLANT MANAGER: Polyethylene film experience required. Ideal Southern location. Salary to $15,000 plus stock option. Excellent opportunity for right man. All replies treated with strictest confidence. Please submit detailed resume to: Box 1501, Modern Plastics.

VINYL CHEMIST.
Manufacturer calendered film and vinyl sheeting requires experienced chemical engineer or chemist. All replies confidential. Location Midwest. Reply Box 1515, Modern Plastics.

INQUIRIES INVITED: from men capable of taking over supervision of our blown tubing and flat film extrusion department. Excellent opportunity awaiting man with best qualifications. Reply Box 1531, Modern Plastics.

SHOP FOREMAN: Vacuum Metallizing Plant. South Jersey area. State age, experience, salary desired. Replies will be held confidential. Reply Box No. 1506, Modern Plastics.

CHALLENGING OPPORTUNITY: for young Chemical Engineer interested in the Brake Lining Industry. Previous experience preferred but not essential. Please send complete resume and state salary to: Personnel Department, The Russell Manufacturing Company, Middletown, Connecticut.

(*Continued on page 302*)


DON'T DOUBT IT! DO IT!
MOLD VINYL HOLLOW GOODS AUTOMATICALLY
MORE ADAPTABILITY! MORE PRODUCTION! MORE PROFITS!
AUTOMATICALLY MOLD AS MANY AS 1620 ITEMS EVERY HOUR
PROCESSED FROM LIQUID PLASTISOL TO A RESILIENT PRODUCT IN ONE CYCLE
COMPLETE OPERATION BY JUST ONE MAN
THIS IS WHAT HAPPENS — AUTOMATICALLY
The above machine converts raw materials into finished goods in one continuous operation. The operator doesn't have to be a technician because all the polyvinyl chloride plastisols are scientifically prepared for you and the automatic features of the machine control the cycle completely. The operator handles only the raw materials and the finished product. The research and technical staffs of many of the nation's foremost companies are available to work out the best formulation for *your* product. You need only be concerned with speed and production.
CONSIDER THE NEW POSSIBILITIES!
Now any hollow article can be molded from vinyl plastisol, vinyl foam or polystyrene expandable beads because this machine adjusts easily to suit all conditions. Think of the new jobs, new orders, bigger profits which can be yours. Think of the many things which now become practical and profitable for you to produce.
ASK FOR MORE INFORMATION — SEE MACHINES OPERATE
Let us show you facts and figures. Let us show you the machine in operation. Let us show you *your own product* being made. Let us make arrangements for your visit to our plant.
THE AKRON PRESFORM MOLD CO.
Phone WA 8-2105
Cuyahoga Falls, Ohio
FORMS LATEX DIPPING
MOLDS STEEL AND ALUMINUM
DIES PLASTIC INJECTION
MACHINERY SPECIAL AUTOMATIC

(*Continued from page 300*)

PLASTICS INJECTION MOLDING: Assistant Superintendent to handle 3 shifts. Must be thoroughly experienced in die set-up, trouble shooting and quality control. Excellent opportunity for right man in Southern California. Reply Box 1508, Modern Plastics.

VINYL COLOR MATCHER.
Man experienced in color matching and production color control in film and sheeting. Reply Box 1516, Modern Plastics.

CUSTOM EXTRUSION: Man needed for expansion of our custom extrusion division. Must be experienced in job set-up using all thermoplastics. Must expect to assume supervisory capacity in due time. Advise experience and other qualifications in resume. Confidence assured. Reply Box 1525, Modern Plastics.

CHEMICAL ENGINEER: an exceptional opportunity for man with 2-5 years experience in application research in processing, compounding and formulating polyvinyl chloride. Prefer experience in calendered plastics, film or sheeting. Familiarity with pilot plant and manufacturing operations essential. This is a career opportunity with a progressive Northern New Jersey manufacturer. Excellent employee benefits. Send full resume including salary required. Box 1509, Modern Plastics.

TILE ENGINEER.
Vinyl tile Engineer or chemist required for new plant. Must have at least two years experience. Excellent opportunity for professional development. Salary commensurate with ability and training.
Reply Box 1533, Modern Plastics.

CHEMICAL ENGINEER: looking for man with at least 5 years' experience in formulation, development and processing of calendered vinyl composition and plastisols. Familiar with plant equipment and operations; have leadership potential and technical supervision experience. Press moulding operations experience desirable. Career opportunity plus excellent employee benefits with a progressive Northern New Jersey manufacturer. Ex-full resume including salary desired. Box 1510, Modern Plastics.

MACHINE DESIGNER WANTED: with some experience on machinery for plastic bags. Good opportunity with large national concern. Reply box 1535, Modern Plastics.

PLASTICS EXTRUSION OPERATOR & Ass't Extrusion Foreman: Wanted by Progressive New York City firm. Pleasant working conditions, chance for advancement unlimited by "seniority" and other restrictions. Excellent opportunity for right man—applications treated with strictest confidence. Write, giving full details to: President, Box 1517, Modern Plastics.

Situations wanted

HARD HITTING: cost minded injection-compression molding specialist with twenty six years experience in all phases of plastic manufacturing desires to locate with a small company where his know-how can be fully utilized. Has plant set up experience. Knows tools, machines, molding techniques and able to take complete charge of operation. Available 2 weeks notice. Might consider investing in small Co. Southeast-South location preferred. Reply Box 1507, Modern Plastics.

PLANT SUPERVISOR: Engineering degree, experienced all phases of Vacuum Forming, processing, mold making, estimating. Presently employed. Will consider allied field. Box 1529, Modern Plastics.

CHEMIST - CHEMICAL ENGINEER: 35, married. Nine years experience; development, testing, experimental, product application in thermosetting materials with large midwest captive molder in the electrical field. Background includes production techniques and equipment, mold design and part cost estimating. Desire affiliation with company directly concerned with marketing plastic products, services, or raw materials. Location unimportant. Reply Box 1522, Modern Plastics.

SUPERVISING ENGINEER: Experienced, young, reinforced plastics. B.S. Ch.E, age 32, desires managerial position. Production estimating, planning, development and set up including preform operations. Direct supervisory and practical experience is coupled with functional knowledge of company operations. Reply Box 1511 Modern Plastics.

Sales agents wanted

EASTERN MACHINE MANUFACTURER: has several good territories open for sales representatives who deal with fabricators of soft vinyl, such as, manufacturers of handbags, belts, advertising novelties, ringbinders, etc. Apply Box 1527, Modern Plastics.

SALES REPRESENTATIVES WANTED: Aggressive, experienced, custom injection molding firm, recognized as a dependable source by key industries, has opening for representation throughout country. We back up with active advertising, engineer's field calls, excellent service at competitive prices. We make our own tools, have paint finishing department. Reply giving territory and sales experience. Commission plus incentive bonuses. Box 1514, Modern Plastics.

POLYETHYLENE SALES.
Spencer seeks a man with enthusiasm, drive and a desire for future progress for a position as Polyethylene Sales Representative. Plastics processing experience is desirable but not necessary. Sales experience is also desirable. Location would be East Coast or Mid-West. Excellent opportunities for future advancement exist in a rapidly expanding organization where annual sales have reached 45 million dollars in its short ten year life. Please send resume of your experience to:
Field Sales Manager
Industrial & Plastics Products
Spencer Chemical Company
Dwight Building
Kansas City, Mo.

OPPORTUNITY: for a representative who understands packaging and who now serves industrial firms, etc. can be had with a fast-growing firm of fabricators via stitching and electronic sealing. Commission basis. State qualifications and territory you cover and lines you carry. All replies will be kept confidential. Reply Box 1503, Modern Plastics.

SALES REPRESENTATIVE WANTED: by custom shape extruder. Interested only in men of proven ability, who are now calling on industrial accounts and handling allied non-competitive lines. Many exclusive territories open. Commission basis. Reply giving qualifications, present representation, and territory desired. Reply to Box 1536, Modern Plastics.

Miscellaneous

WANTED: Injection molds—one item or complete line of proprietary consumer articles, also interested in molds for industrial parts such as knobs, handles, fasteners, boxes, etc. Will consider purchasing complete injection plant with end products or parts line. Designers: New items wanted—cash or royalty. Victory Mfg. Company, 1722 West Arcade Place, Chicago 12, Ill.—Estab. 1930.

COPPER-CLAD PHENOLIC: or other metal-clad plastic laminate—patented process for license or sale—material suited for printed circuits, counter tops. Produces material of higher bond strength, at less cost than conventional method of adhering copper foil to laminate base. Glad to send patent copy to interested parties. Reply Box 1537, Modern Plastics.

NEW PRODUCT DEVELOPMENT ENGINEER: successful experience developing new materials, new products, development contracts, with Defense Agencies wants representation for creative manufacturer in field of plastic laminates, non-wovens, metalized film, adhesive backed materials, foam combinations, etc. Long time Washingtonian, low pressure, solid technical training, wide familiarity Defense Agencies at operating levels where New Product decisions are made. P. O. Box 4915, Washington, D.C.

MANUFACTURERS REPRESENTATIVE & ENGINEER: with excellent well established contacts in the wire and cable field, as well as extruders and custom molders, wishes to represent manufacturer of pelletized or diced vinyl and/or polyethylene compounds for extrusion and molding. Reply Box 1513, Modern Plastics.

PLASTIC LENS CASTING CONSULTANT: Are you presently casting or are you interested in casting abrasion resistant plastic safety, prescription or sunglass lenses? Chemical engineer with several years of development and production experience in the casting, dyeing and edging of these lenses now available for consulting work on a limited time basis. Reply Box 1512, Modern Plastics.

POLYURETHANE.
An elastic foam—ideal for attractive packaging. Our engineers and staff have experience and skill in cutting, printing and shaping this foam for any large or small job. We are specialized fabricators and our experience is immediately available to you. write
Panda Products Corporation,
1388 E. Delavan Ave.,
Buffalo 15, New York.

AUSTRALIAN COMPANY: Young and enterprising, with injection and extrusion plant, interested in contacting American firm for purposes of expansion and development. Investment capital welcomed. Reply to: J. Poser & Co., 251 W. 30th St., N.Y. 1, N. Y.

PLASTICS FABRICATING: Activity desired for purchase. Southern California area preferred. Submit complete details in replying to Box 1524, Modern Plastics.

All classified advertisements payable in advance of publication

Closing date: 28th of the second preceding month, e.g., October 28th for December issue

Up to 60 words $10.00	Up to 120 words $20.00	Up to 180 words $30.00
Up to 60 words (boxed) $20.00	Up to 120 words (boxed) $40.00	Up to 180 words (boxed) $60.00

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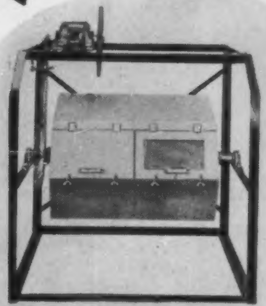
Kramer SOLVES YOUR TUMBLING PROBLEMS



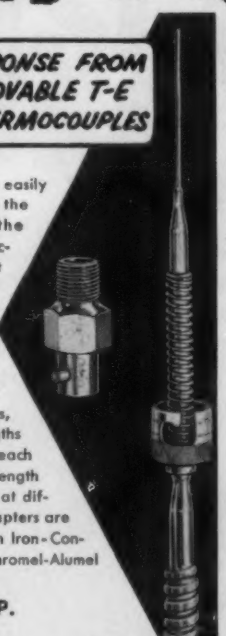
SINGLE BARREL UNIT

Size 30" x 36" or engineered to your specifications. Barrels lined with kiln-dried-and-glued-maple. Child's play to operate — Economical on space — motors are individually mounted overhead-double-decked or single. Tumbling supplies also available.

Write Dept. MP for information

H. W. KRAMER CO.
120-30 JAMAICA AVENUE • RICHMOND HILL 18, N.Y.

GET FAST RESPONSE FROM EASILY REMOVABLE T-E BAYONET THERMOCOUPLES



T-E's bayonet thermocouples are easily installed — a simple twist of the bayonet-lock cap removes the couple. Response is fast and accurate—direct, spring-loaded hot junction contacts are silver tipped with 3/16" O.D. protection tubes, or welded with 1/16" and 1/8" O.D. enclosed "Ceramo" construction. They have many applications—a variety of adapter types and sizes, and different T/C immersion lengths provide the right combination for each installation. Varying adapter length permits use of one thermocouple at different depths. All probes and adapters are of Stainless Steel. Available with Iron-Constantan, Copper-Constantan or Chromel-Alumel elements.

Write for Bulletin 2— P.

Thermo Electric Co., Inc.
SADDLE BROOK, NEW JERSEY
In Canada—THERMO ELECTRIC (Canada) Ltd., Brampton, Ont.

---

another product improved . . .

chem·o·sol®

made this bell and spigot joint a

PERFECT SEAL

Bottle-tight clay pipe joints are now possible—and without the use of hot asphalt or other caulking compounds. **Chem-o-sol**, a specially formulated plastisol, is now used to form the new Wedge-Lock* mechanical joint. Permanent flexibility and amazing durability assure no displacement by roots, or seepage due to strong alkalies or acid wastes.

Our R 5209 Tile Red **chem-o-sol** has been tailored to meet the exacting requirements of this in-plant molding operation. Its fast-fusing property allows for easy stripping of the molds and practically eliminates scrap losses. A complete specification sheet is available on request. (Base **chem-o-sol** will be matched to other shades if so desired.)

R 5209 **chem-o-sol** has the required hardness characteristics over a wide temperature range and exhibits outstanding heat resistance. It is available in drums and tank wagons from our new streamlined plastisol manufacturing facilities. Your request for further data or samples will receive our immediate attention.

*Patents pending by The Robinson Clay Product Co. T.M. Registration Applied For

Chemical Products CP CORPORATION
KING PHILIP ROAD • EAST PROVIDENCE, R. I.

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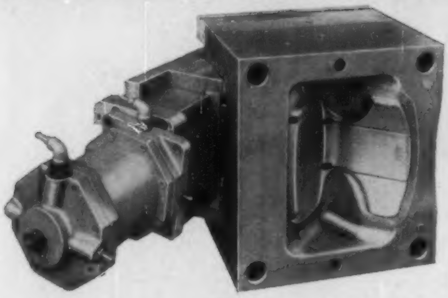
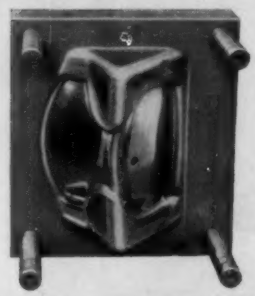
Heat treating problems eliminated on this deep cavity mold...





Cascade mold produces "Baby Bath Seats" from high impact polystyrene on a 48 oz. press operating on a 40 second cycle.

The mold maker—
Damac Tool Co.
New York, N. Y.

The molder—
Curtiss-Wright Corp.
Plastics Division
Quehanna, Pa.

Selected

Cascade prehardened MOLD STEEL

Because...

1 The hardness of prehardened Cascade is uniform throughout . . . especially important in this mold because of the depth of the cavity and core.

2 With a prehardened steel, heat treating problems were eliminated.

3 Cascade polishes faster and to a higher luster. The higher luster results in a superior finish on the molded part.

4 Cascade possesses excellent machinability characteristics.

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